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CLOSURE PLAN

**SWMU 1 - HAZARDOUS WASTE CONTAINER STORAGE AREA
SWMU 17 - OFF-SPECIFICATION PRODUCT STORAGE AREA
VICKSBURG CHEMICAL COMPANY
VICKSBURG, MISSISSIPPI**

Prepared for
Vicksburg Chemical Company
Vicksburg, Mississippi

Cedar Chemical Corporation
Memphis, Tennessee

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WCC File 92B007C

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LIST OF ACRONYMS IN CLOSURE
PLAN, SWMU 1 AND SWMU 17

<u>ACRONYM</u>	<u>MEANING</u>
AOC	Area of Concern
AT	averaging time
B	intake factor
BW	body weight
CF	conversion factor
CLP	contract lab procedures
CRDC	contract required detection limit
CRQL	contract required quantification limit
DINOSEB	dinitro butyl phenol
ED	exposure duration
EF	exposure frequency
EPA	U.S. Environmental Protection Agency
IR	ingestion rate
FI	fraction ingested
K-carb	potassium carbonate
ME	matrix effect
MSDEQ	Mississippi Department of Environmental Quality
MSMA	monosodium methane arsonate
NAPL	non aqueous phase liquids
OVA	organics vapor analyzer
PID	photoionization detector
PVC	poly vinyl chloride
QA/QC	quality assurance/quality control
QAP	quality assurance plan
RAGS	EPA Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act

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<u>ACRONYM</u>	<u>MEANING</u>
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SOW	Statement of Work
SWMU	Solid Waste Management Unit
SS	Site-specific factor
TAL	target analyte list
TCL	target compound list
TDS	total dissolved solids
TOC	Top of Casing
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USCS	Unified Soil Classification System
U.S. EPA	United States Environmental Protection Agency
VCC	Vicksburg Chemical Company
VOA	volatile organic analysis

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INTRODUCTION

Vicksburg Chemical Company (VCC) has retained Woodward-Clyde Consultants (WCC) to perform activities associated with a RCRA corrective action program. The corrective action program is in response to a Consent Decree, Civil Number W92-0008(B). The Consent Decree requires that a RCRA Facility Investigation (RFI) be conducted at the Vicksburg, Mississippi manufacturing facility and that a closure plan be prepared for SWMU 1 - Hazardous Waste Container Storage Area and SWMU 17 - Off-Specification Product Storage Area.

The purpose of the RFI is to determine the nature and extent of releases of hazardous wastes and/or constituents from regulated units, solid waste management units (SWMUs), and other areas of concern (AOCs) at the facility and to gather all necessary data to support a Corrective Measures Study.

The RFI constitutes the second phase of the RCRA corrective action program. The program's initial phase consists of the RCRA Facility Assessment (RFA) which is conducted by EPA and precedes the RFI. The RFI itself is divided into five separate tasks which includes the Preliminary Report (submitted as a separate document in May 1992 and resubmitted as the Amended and Restated Preliminary Report in February 1994), the RFI Work Plan, the Facility Investigation, and the Investigative Analysis and Reports. In addition to these phases, a Groundwater Assessment Work Plan and Annual Groundwater Assessment Reports are required by the Consent Decree.

This document is the closure plan for SWMU 1 - Hazardous Waste Container Storage Area and SWMU 17 - Off-Specification Product Storage Area and includes or incorporates by reference the following plans from the North Pond (SWMU 23) RFI Field Investigation Work Plan (also submitted in February 1994):

- Data Collection Quality Assurance Plan
- Data Management Plan
- Health and Safety Plan

This work plan defines the activities to be executed by VCC pursuant to closure of SWMU 1 and SWMU 17.

1.1 DESCRIPTION OF THE SOUTH PLANT

SWMU 1 and SWMU 17 are located within the South Plant of Vicksburg Chemical Company. Vicksburg Chemical Company is located in Warren County, Mississippi along the Mississippi River within the south section of the City of Vicksburg (see Figure 1a). The address is:

Vicksburg Chemical Company
Post Office Box 821003
Rifle Range Road
Vicksburg, Mississippi 39182

The facility is a manufacturer of chemicals. The plant site is divided physically and functionally into a "north plant" and a "south plant". The north plant is primarily a manufacturer of potassium nitrate, chlorine and nitrogen tetroxide. The south plant formerly manufactured pesticides and herbicides. The south plant presently manufactures nitric acid, which is used primarily as a raw material in the north plant, and potassium carbonate (K-Carb). Some nitric acid and all the K-Carb is sold commercially.

The south plant formerly contained the manufacturing operations for production of the following products:

- Cyanazine
- Methyl parathion
- Atrazine
- Toxaphene
- Dinitrobutyl phenol (dinoseb)
- Monosodium methane arsenate
- Di Ethylhexyl Phosphoric Acid

1.2 HISTORY OF THE SOUTH PLANT

All pesticide plants were shut down by 1986 and have been dismantled. Any non-de minimus spills from toxaphene would have been handled as a hazardous waste (P123). The monosodium methane arsenate (MSMA) plant generated listed RCRA waste K031, a by-product salt. The by-product salt cake was directly discharged into a "roll-off sludge container". When the container was full (2 to 4 days) it was transported by a hazardous waste transporter to a hazardous waste landfill. The MSMA plant was designed such that there was intended to be no effluent with all spills, etc., retained and recycled to the process.

The dinitrobutyl phenol (Dinoseb) plant produced process wastewater that was hazardous by virtue of characteristic (D002). The waste was pumped to 1 to 3 day storage and was transported by a hazardous waste transporter to off-site disposal by hazardous waste deep well injection. At times the manufactured process wastewater was neutralized with ammonia and pumped to a 1.6 million gallon storage tank. After neutralization, the water did not exhibit the characteristic of a hazardous waste and was pumped through activated carbon prior to discharge to the surface impoundment.

The hazardous waste container storage area and off-specification product storage area (see Figure 1 - SWMUs 1 and 17) were in operation from 1976 to 1986. The hazardous waste container storage area stored contaminated debris, trash and waste product material in 55-gallon drums. The off-specification product storage area stored 55-gallon drums and 5-gallon pails of product returned from clients which could be put back into the manufacturing process and recovered.

1.3 DESCRIPTION OF THE CONTAINER STORAGE AREA'S

The two container storage areas which are to be closed are two distinct sections or areas of a continuous concrete area in the South Plant. This area is a 6-inch (minimum) poured 3,000 psi reinforced concrete slab with sumps, curbs, containment areas (see Figure 2).

The hazardous waste container storage area stored trash and debris contaminated with products or by-products produced at the south plant. This area also stored off-specification product which could not be reclaimed or recycled into new product. These waste were typically stored in 55-gallon drums. The area is trapezoidal in shape, approximately 30 feet by 46 feet by 14 feet by 40 feet. Photographs and maps of the area have been included as Figures 3, 4 and 5. The photographs were taken in 1990.

The off-specification product storage area is a covered area immediately adjacent to the hazardous waste storage area but separated by curbs. This is a 2,000 square foot area roughly 28 feet by 70 feet which stored off-specification product until it could be returned to the manufacturing process and recycled into new product. This area stored an assortment of 55-gallon drums, and 5-gallon pails and 1-gallon containers. Photographs and maps of the area have been included as Figures 3 through 7. The photographs were taken in 1990.

1.4 DESCRIPTION OF WASTES STORED

The container storage areas stored off-specification products, products, waste products or trash and debris contaminated with the following chemical compounds:

Toxaphene	(P123)
Dinitrobutyl phenol (dinoseb)	(P020)
Monosodium Methane Arsenate (MSMA)	(K031)
Atrazine	
Toluene contained in pesticide formulations	

The maximum inventory of hazardous wastes is estimated to be 50 drums in the hazardous waste container storage area. The contents of drums stored in the off-specification product storage area were for the most part recycled. It is estimated that at most 10 drums stored at one time were not suitable for recycle and therefore became classified as hazardous waste. SWMU 1 and SWMU 17 areas are no longer active storage areas.

1.5 CLOSURE ACTIVITIES ALREADY PERFORMED

SWMU 1 and SWMU 17 areas are inactive. The areas have been scraped, chipped and scoured such that the surface is free of obvious discoloration from previous use of the areas for storage.

REGULATORY REQUIREMENTS FOR CLOSURE PLAN

This Closure Plan for SWMU 1 and SWMU 17 was prepared in conformance with the applicable closure regulations. Clean closure of the facility will be conducted in a manner that:

- Minimizes the need for further maintenance
- Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.

The plan outlines the closure procedures. In essence the removal of contamination by cleaning activities that have already taken place will be verified by sampling and analysis. If clean closure standards are not met, decontamination activities may be resumed and sampling and analysis for concrete repeated. If it is necessary to excavate the entire floor and surrounding soil to meet clean closure standards, VCC may elect to pursue dirty closure in place or may elect to excavate as noted. If VCC is unable to confirm clean closure by the procedures set forth in this closure plan, VCC will prepare an alternative closure plan.

CLOSURE PROCEDURES

The closure procedures covered in this section apply to closure of SWMU 1 and SWMU 17. The closure procedures are divided into the following steps:

- Notify the MSDEQ and U.S. EPA in writing at least 10 days prior to the date on which sampling of the facility is anticipated to commence.
- Receive approval to implement the closure plan for the MSDEQ and from the U.S. EPA.
- Perform verification sampling and analysis.
- If necessary and practical, further decontaminate SWMU 1 and SWMU 17 to achieve clean closure. Then perform additional verification sampling and analysis. If it is necessary to excavate the entire floor and surrounding soil to meet clean closure standards, VCC may elect to pursue dirty closure in place or may elect to excavate as noted.
- Submit to the MSDEQ and U.S. EPA, by registered mail, a certification that SWMU 1 and SWMU 17 have been closed in accordance with the procedures in the approved closure plan within 60 days of the completion of final closure.

The following sections give detailed descriptions of the activities involved in each phase of closure.

3.1 NOTIFICATION OF INTENT TO CLOSE

SWMU 1 and SWMU 17 areas are no longer active storage areas. SWMU 1 and SWMU 17 have no present useful purpose. After approval of the closure plan and at least 10 days prior to the date on which sampling of the facility is anticipated to

commence, VCC will notify the MSDEQ and U.S. EPA in writing. It is anticipated that the MSDEQ will take split samples.

3.2 ESTIMATES OF MAXIMUM QUANTITY OF INVENTORY

SWMU 1 and SWMU 17 are inactive storage areas. It is anticipated that there will be no waste stored on SWMU 1 and SWMU 17 at the time of closure.

3.3 PROOF OF DECONTAMINATION

Samples of the concrete and samples of soil beneath the concrete will be taken and submitted for analysis. The results of the analysis will be compared to the clean closure standards. The general locations of the areas to be sampled are depicted in Figure 2.

3.3.1 Sampling Rationale

The SWMU 1 and SWMU 17 Closure Work Plan Rationale is based on the fact that it is known which hazardous constituents were stored in or adjacent to the units. For each sample point there would be two or three samples taken:

- A sample of the concrete
- A composite sample of the first six inches of soil beneath the concrete referred to as the shallow sample
- A sample of soil generally 12 inches or deeper beneath the concrete referred to as the deep sample

SWMU 1 will have eight sample points and SWMU 17 will have four sample points.

The total number of samples to be submitted for analysis shall be, as a minimum, as follows:

SWMU Number	Soil	Concrete
1	16	4
17	8	2

The number of sample points will be expanded, if there are evident cracks or fissures of the drainage curb of the concrete pad. The additional sample points will be adjacent to each evident crack or fissure.

3.3.2 Analytical Rationale

The soil and concrete samples submitted for analysis will be analyzed for atrazine, cyanazine, arsenic, dinoseb, toxaphene and toluene.

3.3.3 Sampling Procedures

The following procedures will be employed to sample the soil and concrete under the concrete floor. The positions of the 12 proposed sample locations in warehouse areas, noted in figure 2, are approximate. If there is a crack near the sample point the field sampler is to sample near the crack. A concrete saw or concrete drill will be used to cut or drill and remove a section or plug of the concrete pad. Four samples of concrete from the concrete removed in SWMU 1 and two samples from the concrete removed in SWMU 17 will be submitted for separate analysis with the soil samples. The concrete samples will be wrapped in aluminum foil. The receiving analytical laboratory will grind or otherwise size the concrete samples such that they can be analyzed by procedures established for soil samples.

Samples of soil underneath the concrete will be taken either utilizing a 1-inch diameter stainless steel tube encased in a 2-foot long stainless steel soil probe or a hand auger. Following the removal of the soil probe or auger, the sample will be extracted. The soil sample will be transferred to sample bottles, appropriately labeled, and placed on ice for transport to the laboratory. All equipment will be cleaned in accordance with decontamination procedures before collection of each sample.

Sample points are to be chosen near to locations of joints and/or cracks where contamination could most likely accumulate if released. As a point of reference, according to guidance provided in OSWER 9476-00-8.C, a clean closure demonstration may be made with one sample per 2500 ft² assuming the area and depth to be sampled

are not highly variable. The areal locations meet the criterion noted. The mobility of pesticides in soil underneath the concrete will be limited; therefore, the highest concentrations would likely be found in areas where there are cracks just below the concrete/soil interface. If anomalies are found during sampling, additional samples will be taken. When analyses are obtained and reviewed, it may also become evident that a second round of sampling and analysis is required.

All equipment will initially be decontaminated before use and again after each sample is collected. The following decontamination procedures will be employed:

- Washing in tap water and a detergent (Alconox) solution. Brush, if necessary, to remove particulate matter and surface films.
- Rinsing thoroughly with tap water.
- Rinsing with distilled, deionized water.
- Rinsing twice with pesticide - grade solvent.
- Rinsing with organic - free water.
- Allow to air dry as long as possible.

After decontaminating, the sample equipment will be wrapped in aluminum foil for protection until its subsequent use. All wash fluids will be containerized for later disposal by VCC.

After sampling, all sample points will be grouted and sealed.

The Data Collection Quality Assurance Plan and Data Management Plan are attached and incorporated by reference. The plans are from the North Pond RFI Work Plan and are to be used as guidance where parameters and techniques are applicable. The Health and Safety Plan to be used for all VCC work by WCC is attached.

3.3.4 Documentation of Sample Acquisition

All information pertinent to field observations and sampling will be recorded in a logbook with consecutively numbered pages. Entries in the logbook will include at least the following:

- Sketch of the container storage area with measurements
- A grid of the site area
- Purpose of Sampling
- Number and approximate volume of samples taken
- Location of sampling point on grid
- Description of sampling point
- Date and time of collection
- Collector's sample identification number(s)
- References, such as maps or photographs of the sampling site
- Field observations
- Weather conditions

The documentation in the logbook will be sufficient to reconstruct the sampling situation without relying on the collector's memory.

Proper sample preservation is important in retaining the sample characteristics prior to analysis. Sample preservation is documented on the chain-of-custody form and also in the field logbook. The proposed analytical methods required that the sample be kept on ice until transferred to the laboratory.

Once the sample has been transferred to an appropriate laboratory sample container, sample tags will be completed and affixed to the sample container. The concrete samples will be wrapped in aluminum foil.

3.3.4.1 Sample Tagging

Each sample will be tagged and sealed properly immediately after collection. Sample tags are necessary to prevent misidentification of samples. The tag will include at least the following information:

- Name of collection
- Date and time of collection
- Place of collection
- Collector's sample number, which uniquely identifies the sample

3.3.4.2 Chain-of-Custody

In addition in the field logbook, each sample will be recorded on a chain-of-custody record. An identifying code will be assigned to each sample and this code will be used on the chain-of-custody and in the logbook to ensure that the sample description is identifiable. A brief description of the sampling point will also be placed on the chain-of-custody form.

Chain-of-custody forms will become the permanent records of all sample handling and shipment. If standard sampling procedures are not used, a written justification of each deviation will be placed in the project file. Upon completion of sampling, the sample will be prepared for shipment in accordance with the applicable sampling instruction, including preservation, labeling, and logging.

The person collecting a sample will initiate the document(s) at the source of sample and start the chain-of-custody procedure.

The sample will be kept in a limited access or locked storage at the proper temperature until custody is relinquished from the site and formal documentation of the transfer is completed.

Upon transfer of the custody, the person involved will verify sample numbers and condition and will document the sample acquisition and transfer. The field sampler will properly package the samples, indicate method of shipping, obtain documentation of the shipment, such as certified mail receipt or bill of lading number, and sample identification records (one of each with the shipment, one of each by mail to the laboratory, and one of each returned with field records).

On transfer of custody of the samples to the transport agency, the field sample custodian will sign and retain a copy of the chain-of-custody, witness the transport company custody signature, and send two copies of the chain-of-custody, witness the transport company custody signature, and send two copies of the chain-of-custody with the samples. On arrival at the laboratory, the sample custodian will sign for custody and

return a copy of the completed chain-of-custody to VCC. Custody procedures will then proceed according to the procedures of the selected testing laboratory.

3.3.4.3 Analytical Methods and Parameters

A summary of the parameter and possible methods to be employed by the offsite laboratory are as follows:

Toxaphene, Atrazine and Cyanazine	EPA SW-846, Method 8080
Dinitrobutyl Phenol (Dinoseb)	EPA SW-846, Method 8150
Arsenic	EPA SW-846, Method 7060
Toluene	EPA SW-846, Method 8020

VCC will use Analytical Technologies in Pensacola, Florida or an equally qualified laboratory as the off-site laboratory.

The concrete cores or chunks will require special sample preparation. The entire core or chunk of concrete will be pulverized. Then the entire sample will be ground or otherwise subdivided such that it passes through a 1 millimeter sieve. During the extraction phase of sample preparation where acidification to pH 2.0 is required, only concentrated hydrochloric acid will be used. Sufficient hydrochloric acid will be used such that the pH remains at 2.0 during the entire extraction. The pH at the end of the extraction period will be recorded.

3.3.5 Evaluation of Data

Upon completion of the sampling, the next step will involve the analysis of data collected. The data will be compared to the Clean Closure Criteria.

3.4 CLEAN CLOSURE CRITERIA

The clean closure standards are based upon closure of both container storage areas with no contamination remaining in place above the health based action levels. This plan is intended to result in a "clean" closure which will eliminate the need for post-closure maintenance and care of the storage areas. The levels of clean-up will be used for the soils underneath the concrete as well as the concrete. The following are the health based closure standards for soils and concrete, assuming that the exposure pathway is ingestion, and the receptors are workers at the site. This assumption will require a restriction on future land use at the site. (See OWSER Directive No. 9355.7-04, Land Use in the CERCLA Remedy Selection Process, May 25, 1995).

Constituent	Concentration (mg/kg)
Dinoseb	80
Arsenic	1.8
Toxaphene	2.6
Atrazine	400
Toluene	16,000

Clean closure standards for soil leachate require that concentrations in TCLP extract of the soil shall not exceed MCLs. Where MCLs have not been established, concentrations in the TCLP extract of the soil shall not exceed health based levels calculated, using a consumption rate of 2 liters of leachate per day.

The basis for the calculations is included in the following paragraphs.

3.4.1 Methodology for Calculation of Cleanup Criteria

The development of site-specific health-based remedial goals is based on the health risk assessment process in accordance with EPA Risk Assessment Guidelines for Superfund (RAGS). Remedial goals for the identified constituents of potential concern are obtained through backcalculation of health risk estimation calculations.

Cleanup goals are usually governed by potential carcinogens found onsite although cleanup goals for noncarcinogenic compounds may also be evaluated. Where toxicity values for the evaluation of both carcinogenic and noncarcinogenic health effects are available, cleanup criteria were calculated for both and cleanup criteria will be established based on the more conservative chemical concentration calculated.

3.4.1.1 Calculations of Cancer Risk

The calculation of cancer risk is summarized in the following table:

Concentration of Constituent in Medium (mg/kg)	Receptor Specific Intake Factor (kg/kg/day)	Lifetime Average Daily Intake (mg/kg/day)	Slope Factor (mg/kg/day) ⁻¹	Cancer Risk
A	B	C	D	E
		$C = (A)(B)$		$E = (C)(D)$

3.4.1.2 Calculation of Noncarcinogenic Health Effects (Hazard Quotient)

The calculation of the potential for noncarcinogenic health effects, called the hazard quotient, is summarized as follows:

Concentration of Constituent in Medium (mg/kg)	Receptor Specific Intake Factor (kg/kg/day)	Average Daily Intake (mg/kg/day)	Reference Dose RfD (mg/kg/day)	Hazard Quotient
A	B	C	D	E
		$C = (A)(B)$		$E = (C)/(D)$

3.4.1.3 Cleanup Criteria Calculations for Carcinogens

To derive site-specific concentrations in a medium that are protective of human health, the calculations presented above are reversed. For carcinogens, an acceptable cancer risk level is designated by experienced practitioners and divided by the slope factor to yield the acceptable daily chemical intake. The acceptable lifetime average daily intake

is then divided by the intake factor to obtain an acceptable concentration of chemical in the medium; i.e., a chemical-specific cleanup goal.

Acceptable Cancer Risk	Slope Factor (mg/kg/day) ⁻¹	Lifetime Average Daily Intake (mg/kg/day)	Receptor Specific Intake Factor (kg/kg/day)	Concentration of Constituents in Medium (mg/kg)
E	D	C	B	A
		$C = (E)/(D)$		$A = (C)/(B)$

3.4.1.4 Cleanup Criteria Calculations for Noncarcinogens

For noncarcinogenic constituents, the hazard quotient is assigned an acceptable value by experienced practitioners and is multiplied by the reference dose to yield the acceptable average daily chemical intake. The acceptable daily chemical intake is divided by the intake factor to obtain the acceptable concentration of chemical in the medium; i.e., a chemical-specific cleanup goal.

Acceptable Hazard Quotient	RfD (mg/kg/day)	Average Daily Intake (mg/kg/day)	Intake Factor (kg/kg/day)	Acceptable Chemical Concentration (mg/kg)
E	D	C	B	A
		$C = (E)(D)$		$A = (C)/(B)$

3.4.1.5 Target Cancer Risks

An acceptable level of potential cancer risk is selected after evaluation of site variables including the types and activities of receptors on or near the site, types of potential exposures, the inherent toxicity of chemicals found on or near the site, and the EPA guidelines governing remedial goals and risk management decisions (OSWER Directive 9355.0-30).

A potential cancer risk of 1×10^{-6} has been selected for the site because of the contaminant toxaphene. This level of potential risk has been selected based on the following:

- Access by the public is restricted. There is 24 hour site security.
- Future site use will continue be industrial/commercial.
- Topographic and hydrologic analysis indicates that potential exposure to residential receptors is not likely to occur.
- Potential future exposures will be solely related to the duration and frequency with which workers are on-site.
- The potential carcinogens on the site are known to induce unrelated target organ-specific effects, therefore potential carcinogenicity should not be treated as additive.
- EPA guidelines state that for the calculation of cleanup goals for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of 10^{-4} (EPA OSWER Directive 9355.0-30).
- The EPA Hazardous Waste Identification Committee has specified a level of hazardous constituents, known as the "bright line", below which contaminated media would be considered lower-level hazards and would fall outside the RCRA Subtitle C regulations. The risk factor for hazardous constituents of the "bright line" is identified as 10^{-3} .

3.4.1.6 Target Hazard Quotient

A target potential hazard quotient of 0.08 has been selected for each contaminant for the development of soil cleanup criteria at the former pesticide facility. A total hazard

quotient less than 1 represents an exposure level that is without adverse health effects in exposed populations (EPA RAGS).

3.4.2 Specific Calculations for SWMU 1 and SWMU 17 - Carcinogens

Based on the site-specific information noted in Section 3.4.1.5, an intake factor is calculated:

$$\begin{aligned}
 B = \text{Intake Factor} &= \frac{(IR) (EF) (ED) (ME) (FI) (CF) (SS)}{(BW) (AT)} \\
 &= \frac{(100 \text{ mg/day}) (250 \text{ days/yr}) (25 \text{ years}) (1 \times 10^{-6} \text{ kg/mg})}{(70 \text{ kg}) (365 \text{ days/yr} \times 70 \text{ years})} \\
 &= 3.48 \times 10^{-7} \text{ kg/kg/day}
 \end{aligned}$$

where:

IR	=	Ingestion rate (mg soil/day) 50 mg/day (OSWER Directive 9285.6-0.3, "Standard Default Exposure Factors", 3/25/91) Use 100 mg/day in calculation
FI	=	Fraction ingested from contaminated source (unitless) Pathway-specific value (should consider contaminant location and population activity pattern); use FI = 1 as a conservative assumption
EF	=	Exposure frequency (days/year) 250 workdays/year at Vicksburg Chemical
ED	=	Exposure duration (years) 25 years for Vicksburg Chemical workers
CF	=	Conversion factor (10 ⁻⁶ kg/mg)

- BW = Body weight (kg)
70 kg (adult, average; EPA 1989d)
- AT = Averaging time (period over which exposure is averaged, days)
Pathway-specific period of exposure for noncarcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)
- ME = Matrix effect; use 1 as a conservative assumption
- SS = Site-specific factor; use 1 as a conservative assumption

The following table is then prepared from calculations of noncumulative carcinogenic exposure:

	Acceptable Risk Goal	Oral Slope Factor (mg/kg/day) ⁻¹	Acceptable Lifetime Average Daily Chemical Intake (mg/kg/day)	Intake Factor (kg/kg/day)	Acceptable Concentration in Soil (ppm or mg/kg)
	E	D	C = (E)/(D)	B	A = (C)/(B)
Toxaphene	10 ⁻⁶	1.1E+00	9.1E-07	3.48E-07	2.6 ppm
Arsenic	10 ⁻⁶	1.6E+00	6.25E-07	3.48E-07	1.8 ppm

3.4.3 Specific Calculations for SWMU 1 and SWMU 17 - Noncarcinogens

The intake factor is similar to the carcinogen calculation except that AT = (365 days/yr x 25 years).

$$\begin{aligned}
 B = \text{Intake Factor} &= \frac{(IR) (EF) (ED) (ME) (FI) (CF) (SS)}{(BW) (AT)} \\
 &= \frac{(100 \text{ mg/day}) (250 \text{ days/yr}) (25 \text{ years}) (1 \times 10^{-6} \text{ kg/mg})}{(70 \text{ kg}) (365 \text{ days/yr} \times 25 \text{ years})} \\
 &= 1 \times 10^{-6} \text{ kg/kg/day}
 \end{aligned}$$

The following table is then prepared from calculations of noncarcinogenic exposure:

	Acceptable HQ Goal (mg/kg)	Oral RfD (mg/kg/day)	Acceptable Average Daily Chemical Intake (mg/kg/day)	Intake Factor (kg/kg/day)	Acceptable Concentration in Soil (ppm or mg/kg)
	E	D	C = (E)(D)	B	A = (C)/(B)
Atrazine	0.08	5E-03	4E-04	1E-06	400 ppm
Dinoseb	0.08	1E-03	0.8E-04	1E-06	80 ppm
Arsenic	0.08	3E-04	0.24E-04	1E-06	24 ppm
Toluene	0.08	2E-01	160E-04	1E-06	16,000 ppm

For noncarcinogens, the potential hazard could be viewed as additive since dinoseb, atrazine and possibly arsenic are known to induce some form of reproductive toxicity. The cumulative hazard index (sum of the hazard quotients) is less than 1.0, which indicates the absence of health effects in humans assuming additivity of effects.

3.5 FURTHER DECONTAMINATION OF CONCRETE

If the clean closure standards are not met for the concrete, VCC may wash with high pressure sprays and detergent solutions of the following mixtures:

Type of Residue Suspected	Solution	Directions of Preparation
1. Inorganic acids, ammonia.	A	To 10 gallons of water, ionic metals, add 4 pounds of sodium carbonate (soda lime) and 4 pounds of trisodium phosphate. Stir until thoroughly mixed.

Type of Residue Suspected	Solution	Directions of Preparation
2. Cyanides and other nonacidic inorganic residues.	B	To 10 gallons of water, add 8 pounds of calcium hypochlorite and 1/2 pound of sodium hydroxide. Stir with wooden or plastic stirrer until thoroughly mixed.
3. Solvents and organic compounds such as trichloroethylene and toluene.	C (or A)	To 10 gallons of water, add 4 pounds of trisodium phosphate. Stir until thoroughly mixed.
4. Oily, greasy, unspecified residues.	C	Same as item 3.
5. Inorganic bases, alkali and caustic residue.	D	To 10 gallons of water, add 1 pint of concentrated sulfuric acid. Stir with a wooden or plastic stirrer.

The sampling and analysis of the concrete would then proceed as previously described. If clean closure standards are finally not met, VCC will proceed with an alternative closure plan as described in Section 7.0.

CLOSURE CERTIFICATION

Closure certification by an independent professional engineer will be submitted to the MDEQ and U.S. EPA within 60 days of completion of closure. The independent, registered professional engineer or his authorized representative will document all activities associated with closure. Such documentation will include, at a minimum, daily field logs and a summary technical report. The summary technical report will provide information for evaluating the adequateness of closure procedures. The report will also include documentation of any field or off-site laboratory tests performed to verify compliance with the closure plan. The closure certification, bearing the engineer's certification and seal, will be submitted to the MSDEQ and U.S. EPA within 60 days of completion of closure.

CLOSURE COST ESTIMATE

The following is the closure cost estimate:

Step	Unit Cost (\$)	Quantity	Subtotal (\$)
• Laboratory Analysis Onsite ¹	N/A	N/A	N/A
• Removal of Concrete Plugs	500/day	2	1,000
• Transportation and Disposal	500/ton	1	500
• Laboratory Analysis Offsite ²	450	35	15,750
• Concrete Pad Decontamination (as needed)			
- Mobilization			500
- High pressure detergent wash (or alternative)	1,000/day	10	10,000
• Reanalysis (as needed)	450	15	6,750
• Closure Report	600/day	3	1,800
• Closure Certification	800/day	1	800
• Sampling Labor	1,200/day	2	2,400
• Project Management	800/day	1	800
• Transportation and Expenses			2,000
TOTAL			42,300

NOTES:

¹ Vicksburg Chemical may use its onsite laboratory for rapid field analysis for screening purposes not written into closure plan.

² Vicksburg Chemical will use an offsite laboratory for decontamination confirmatory analysis.

CLOSURE SCHEDULE

The following is the schedule of closure:

Step	Day
• Receive approval to proceed with closure plan.	0
• Receive approval to implement RFI work plan for entire facility.	x
• Provide funds for closure trust	x + 10
• Notify MSDEQ and U.S. EPA of sampling date	x + 10
• Begin sampling	x + 30
• Review results of sampling	x + 60
• If needed, hire contractor to conduct high pressure detergent wash or alternative	x + 90
• Begin resampling	x + 120
• Review results of resampling	x + 150
• Complete certification report	x + 210

CONTINGENT CLOSURE PLAN

It is VCC's clear intention to achieve clean closure. In the event that VCC is unable to confirm clean closure by the procedures set forth in this closure plan, VCC will prepare an alternative closure plan. The closure plan will consist of one of the following options:

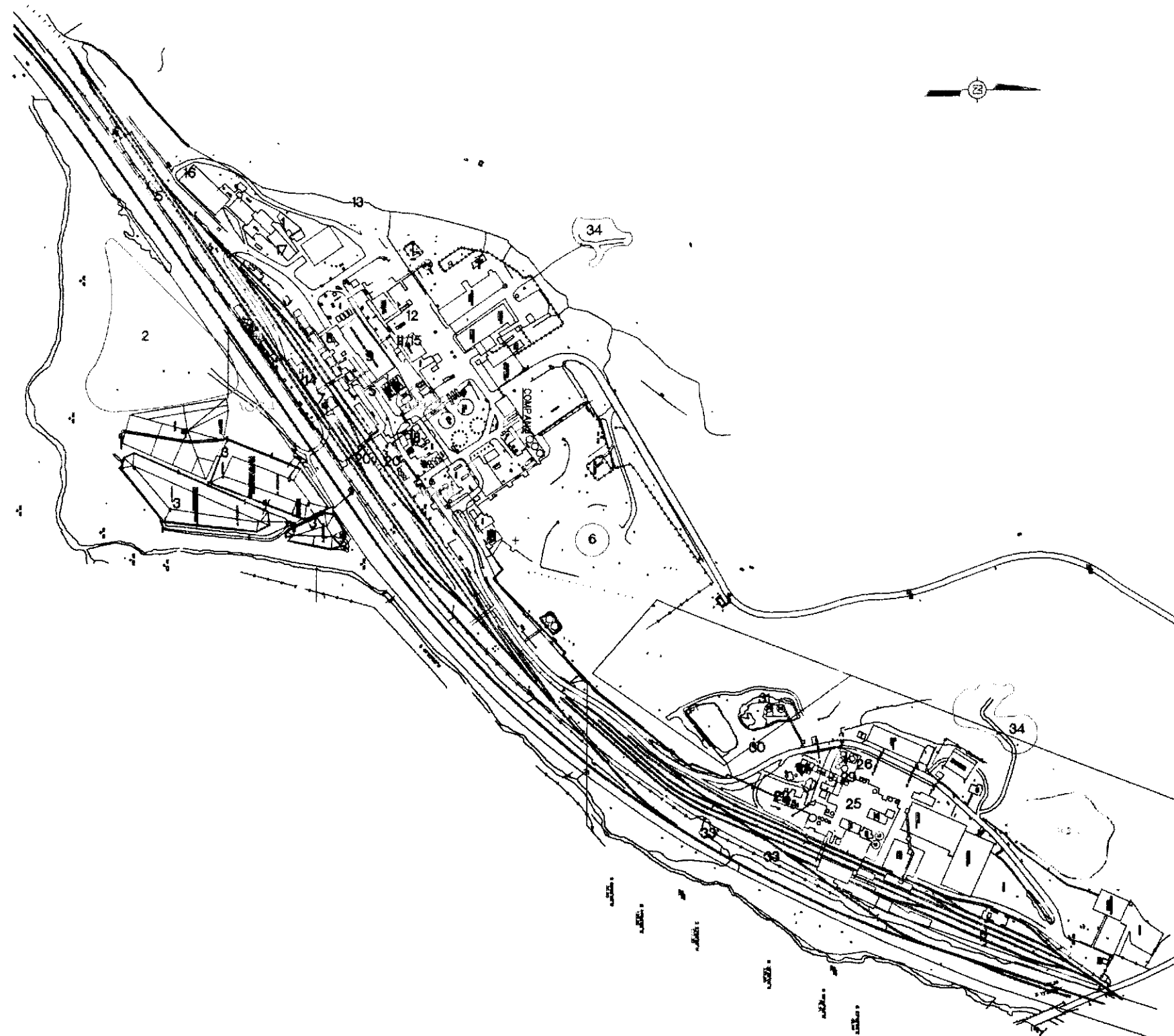
- Excavation of contaminated concrete and soil and treatment and/or disposal on-site.
- Excavation of contaminated concrete and soil and treatment and/or disposal off-site.
- Redefine the unit as a corrective action landfill, undergo post-closure, and obtain a post-closure permit. In this instance, installation of a groundwater monitoring system for the unit would also be required.

POST CLOSURE CARE

In the event that it is necessary to execute the landfill contingent closure plan, monitoring and maintenance will be required for a period of 30 years. The contingent closure plan would include the installation of one well upgradient and three wells downgradient. Monitoring will consist of sampling and analyzing the wells semi-annually for a period of 2 years and annually for 28 years. The analytes will be toxaphene, dinoseb, arsenic, atrazine and toluene. Details on post closure care would be submitted with the contingent closure plan and post closure permit application.

FINANCIAL ASSURANCE

Upon approval of this plan by MSDEQ and the U.S. EPA, VCC will establish a proper financial vehicle concurrent with the execution of the work. A copy of the trust agreement that will be executed is attached as Appendix G.



SWMU NUMBER

SOUTH PLANT

- 1 CONTAINER (DRUM) STORAGE AREA
- 2 INACTIVE LANDFILL
- 3 SURFACE IMPOUNDMENT (SOUTH PLANT)
- 4 ACTIVATED CARBON TREATMENT UNITS
- 5 SOUTH PLANT DRAINAGE SYSTEMS
- 6 WASTEWATER STORAGE (HILL) TANKS
- 7 FORMER DINOSEB PRODUCTION AREA
- 8 DINOSEB LOADING/UNLOADING AREA
- 9 DINOSEB DRUMMING AREA
- 11 FORMER MSMA PRODUCTION AREA
- 12 FORMER MSMA SALT UNLOADING AREA
- 13 SOUTH PLANT DRAINAGE DITCHES
- 14 FORMER TOXAPHENE PRODUCTION AREA
- 15 FORMER METHYL PARATHION PRODUCTION AREA
- 16 FORMER ATRAZINE PRODUCTION AREA
- 17 RETURNED PRODUCT STORAGE AREA
- 18 FORMER BLUE TANK AREA
- 20 RAILROAD CAR UNLOADING STATION

NORTH PLANT

- 22 NORTH PLANT NEUTRALIZATION SYSTEM
- 23 EQUALIZATION/NEUTRALIZATION POND (NORTH PLANT)
- 25 NORTH PLANT WASTEWATER PIPES
- 26 C-10 SCRUBBER
- 29 OIL COLLECTION UNIT
- 30 NORTH PLANT WASTE OIL ACCUMULATION AREA
- 31 NO. 6 FUEL OIL AREA
- 33 NORTH PLANT DRAINAGE DITCHES

BOTH PLANTS

- 34 SURPLUS EQUIPMENT STORAGE (JUNKYARD)

AOC NUMBER

AOC NAME

- 1 FISH POND (NORTH PLANT)
- 2 DRUM STORAGE AREA
- 3 NEUTRALIZATION TANKS (SOUTH PLANT)
- 4 CHEMICAL CRYPT (SEPTIC TANKS)



NO.	REVISION	DATE	INITIAL

SWMU 1 and SWMU 17 CLOSURE PLAN

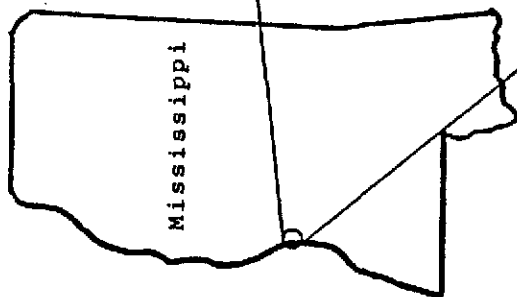
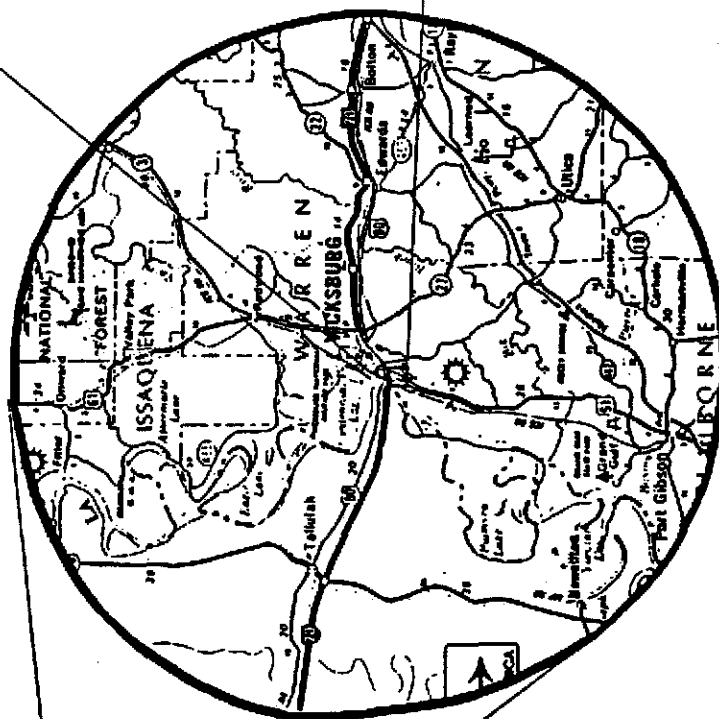
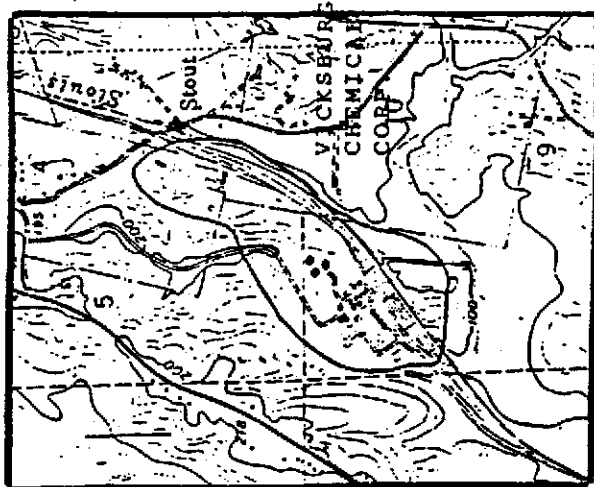
WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists
and Environmental Scientists
Baton Rouge, Louisiana

CEDAR CHEMICAL CORPORATION
VICKSBURG CHEMICAL DIVISION
VICKSBURG, MISSISSIPPI

SCALE: 1"=200' MADE BY: GT DATE: 4/6/92 FILE NO. 92B007C
CHECKED BY: DATE: 4/6/92

LOCATION OF SOLID WASTE
MANAGEMENT UNITS

FIGURE
1



DAR CHEMICAL CORP
 VICKSBURG CHEMICAL
 DIVISION
 VICKSBURG, MISSISSIPPI

Woodward-Clyde Consultants
 Consulting Engineers, Geologists
 and Environmental Scientists
 Baton Rouge, Louisiana

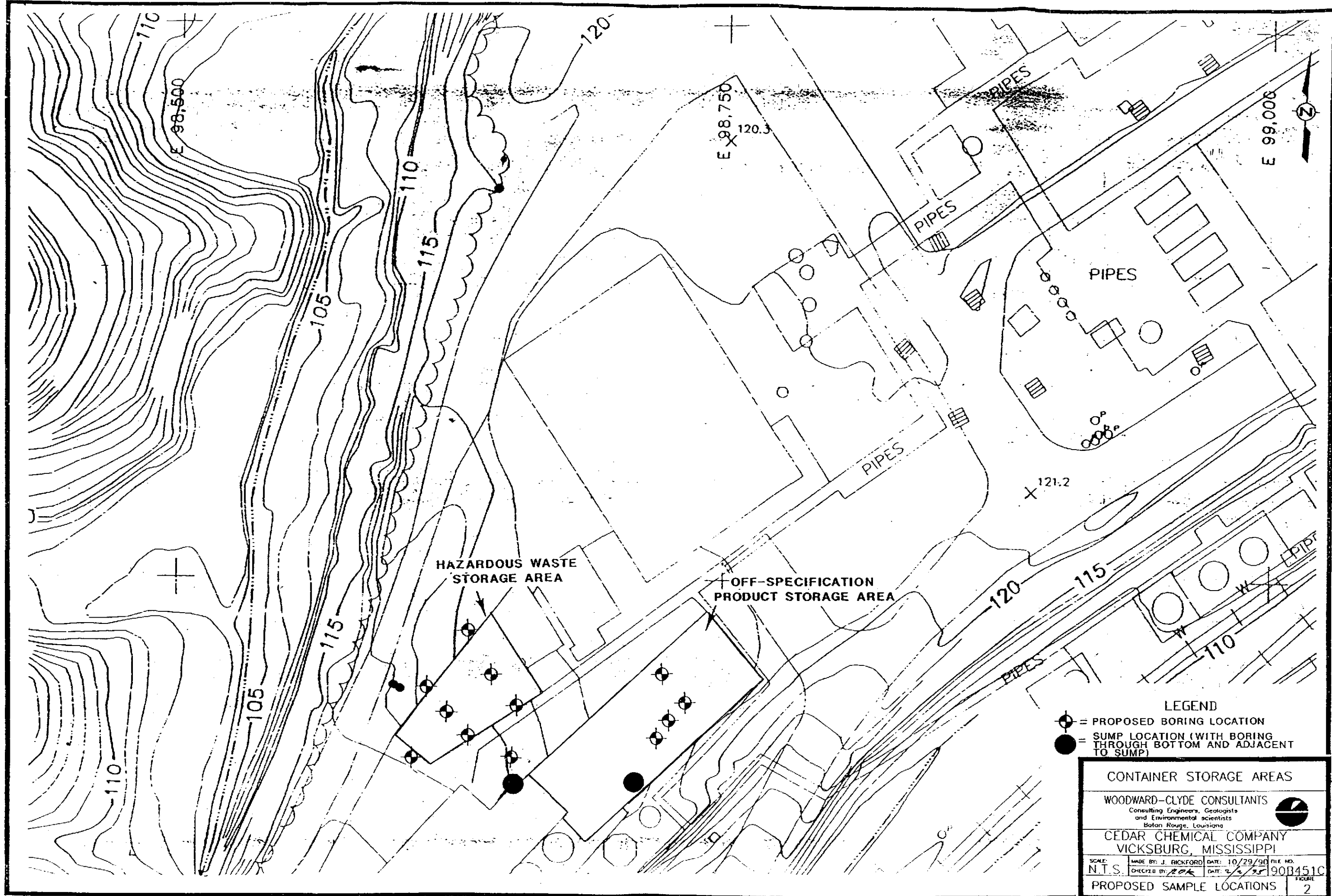


SCALE:	DRAWN BY: SB	DATE: 4/91
	CHKD. BY:	DATE:

FACILITY LOCATION MAP

FILE NO.
 92B007C

FIG. NO.
 1a



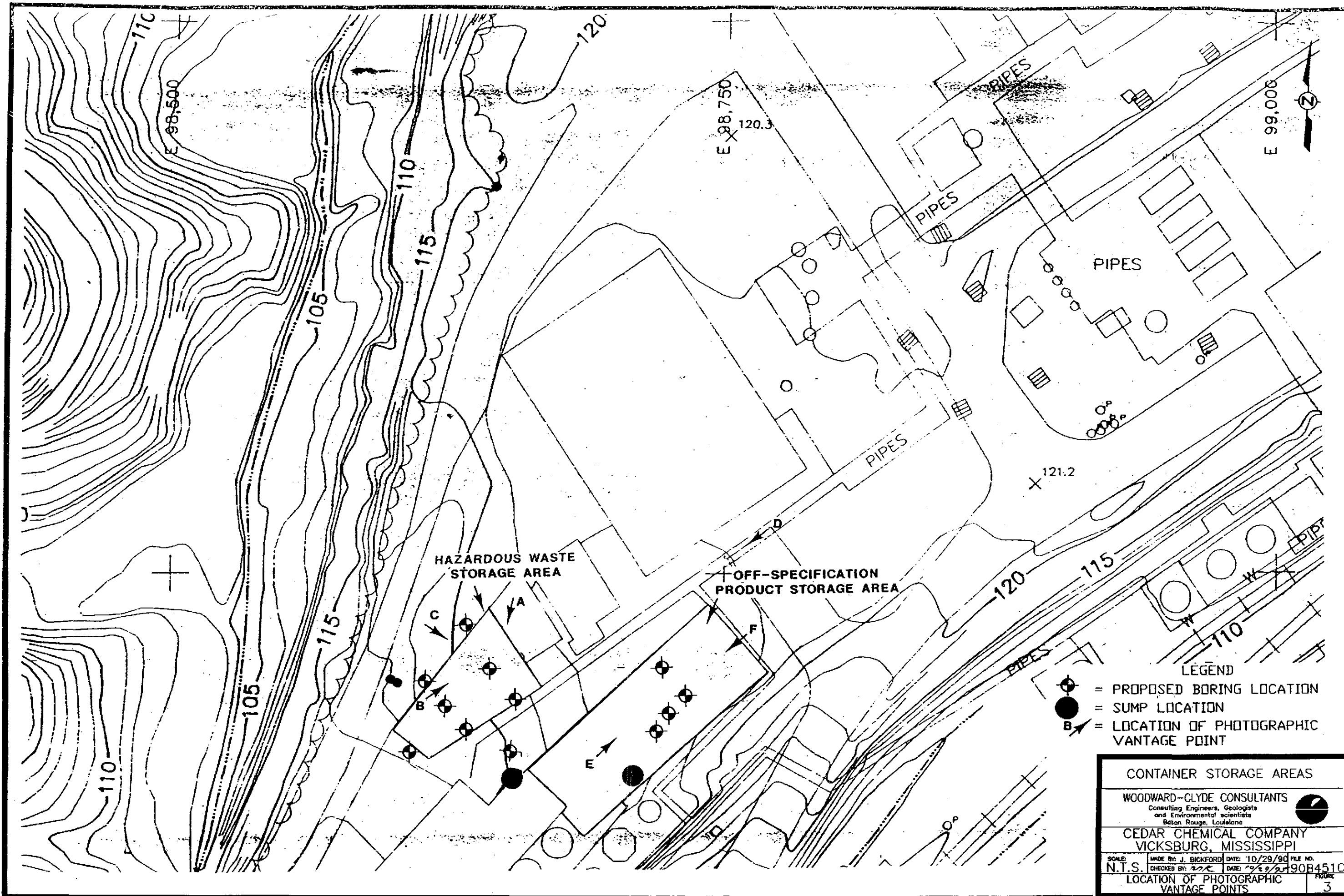
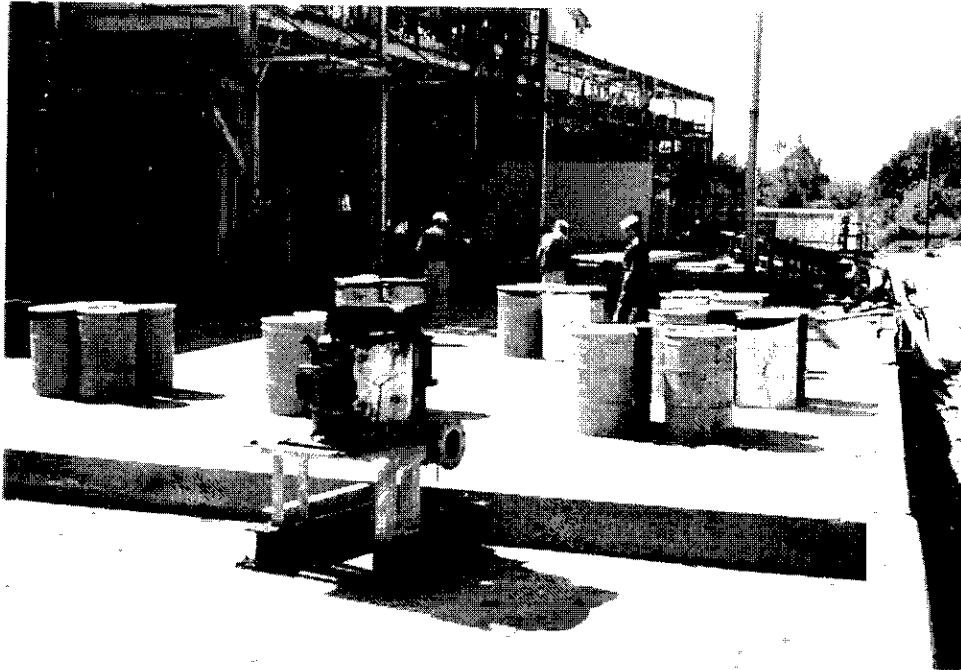


FIGURE 4

**PHOTOGRAPHS OF HAZARDOUS WASTE STORAGE AREA
(REFER TO FIGURE 3 FOR VANTAGE POINTS)**



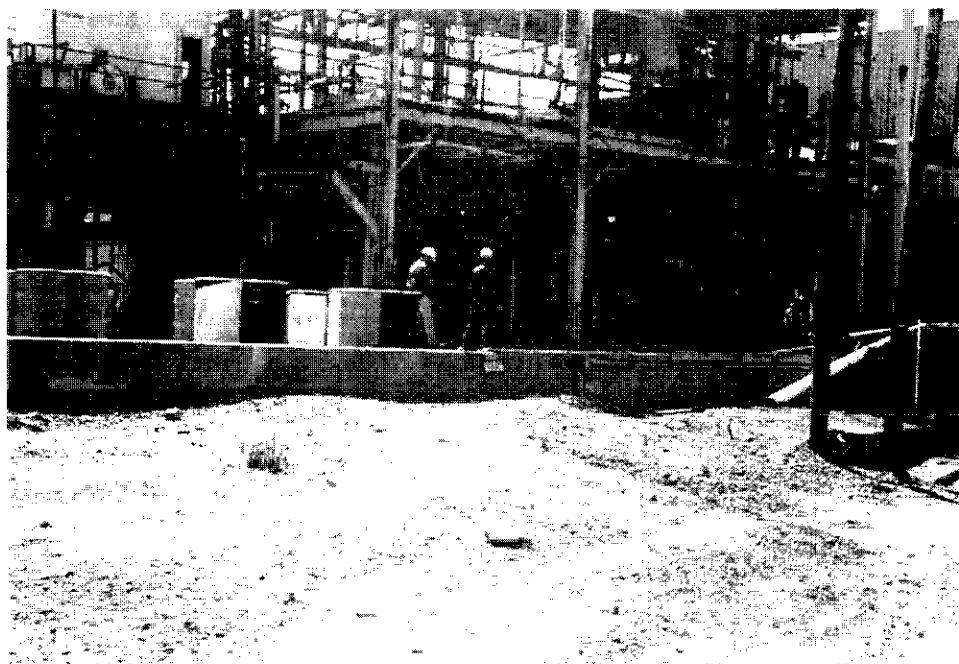
A



B

FIGURE 5

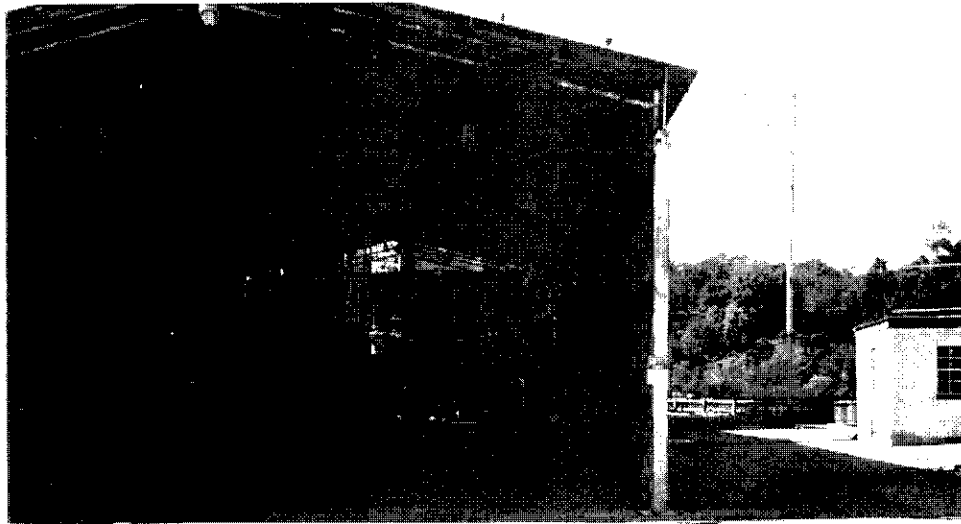
**PHOTOGRAPHS OF HAZARDOUS WASTE STORAGE AREA
(REFER TO FIGURE 3 FOR VANTAGE POINTS)**



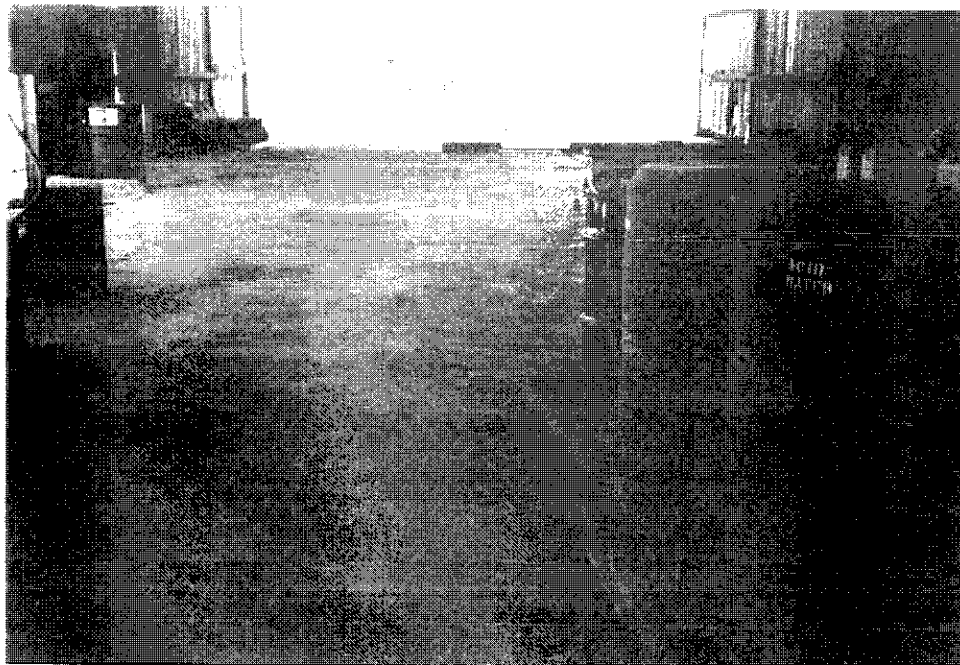
C

FIGURE 6

**PHOTOGRAPHS OF OFF-SPECIFICATION
PRODUCT STORAGE AREA
(REFER TO FIGURE 3 FOR VANTAGE POINTS)**



D



E

FIGURE 7

**PHOTOGRAPHS OF OFF-SPECIFICATION
PRODUCT STORAGE AREA
(REFER TO FIGURE 3 FOR VANTAGE POINTS)**



F

CHAIN - OF - CUSTODY RECORD

[illegible]

SAMPLE COLLECTION:

PROJECT NO. AND NAME _____

LOCATION OF SAMPLE: _____

TEAM LEADER: _____ TELEPHONE: () _____

COMPANY NAME: _____

ADDRESS: _____

WITNESS: _____ COMPANY NAME: _____

FIELD INFORMATION:

TYPES OF SAMPLES: LIQUID (LI) FISH (FI) SLUDGE (SL) SOIL (SO)
(MATRIX) WIPE (WI) SEDIMENT (SE) OTHER (SPECIFY) _____

FIELD NOTES: _____

TRANSPORTER: _____ AIRBILL/INVOICE: _____ DESTINATION: _____

SAMPLE TRANSFER (Original must be retained with sample at all times)

		RELINQUISHED BY	DATE/TIME	RECEIVED BY	DATE/TIME
1	NAME:				
	COMPANY:				
2	NAME:				
	COMPANY:				
3	NAME:				
	COMPANY:				

TERMINATION OF CHAIN-OF-CUSTODY:

AUTHORIZED BY: _____ DATE: _____ TIME: _____

COMPANY NAME: _____

SAMPLE DISPOSTION: STORAGE _____ DISPOSAL _____ OTHER _____

EXAMPLE OF SAMPLE LOG

SAMPLE I.D.

PROJECT NUMBER _____

PROJECT NAME _____

EXACT SAMPLING LOCATION _____

FIELD TESTS	MATERIAL SAMPLED	PRESERVATIVE
DVA	SOLID WASTE <input type="checkbox"/>	NONE <input type="checkbox"/>
pH	LIO. WASTE <input type="checkbox"/>	ICE <input type="checkbox"/>
SALINITY	SOIL <input type="checkbox"/>	H ₂ SO ₄ <input type="checkbox"/>
S. COND.	G. WATER <input type="checkbox"/>	HNO ₃ <input type="checkbox"/>
TEMP	S. WATER <input type="checkbox"/>	OTHER <input type="checkbox"/>
OTHER	OTHER <input type="checkbox"/>	

REMARKS _____

WEATHER _____ TIME _____

SIGNATURE _____ DATE _____

Figure 9

APPENDIX A

CEDAR CHEMICAL DINOSEB TEST METHOD

Dinoseb in Soil - Spectrophotometric Method

A. Sample Preparation

1. Slurry 10 grams of soil in 100 mls of water in a 250 ml beaker.
2. Make alkaline to pH > 10 with NaOH.
3. Place stirring bar in beaker and stir for 15 minutes.
4. Filter slurry through glass fiber filter paper and wash with two successive 50 ml portions of water.
5. Make up to standard volume in volumetric flask.

B. Sample Analysis

1. Prepare a 10 ppm standard solution of Dinoseb from stock solution.
2. Dilute the 10 ppm standard 2:1 and 5:1 in clean volumetric glassware to give three concentrations for preparation of a standard curve.
3. Read the adsorbances of the standards and plot the values to prepare the standard curve.
 - a. Set the spectrophotometer at 380 nm wavelength.
 - b. Prepare a blank by acidifying a portion of the unknown sample to pH 3 or less to remove color.
 - c. Zero and span and instrument to 0 and 100% transmittance with the blank and a light blocker.
 - d. After reading the standards and preparing a standard curve, read the unknown sample. If the sample absorbance is too high, dilute a portion to a known volume and read again.
 - e. Compare the absorbance of the unknown to the standards to determine the concentration of Dinoseb in extract from the soil sample. Adjust calculations for aliquoting.
 - f. From the dry weight of the sample and the amount of Dinoseb in the extract, calculate the concentration in the soil sample.

This method is a suitable screen for the presence and general quantitation of Dinoseb. Interferences from other compounds having similar adsorption curves is possible. More exact determinations should be made using gas-liquid chromatographic techniques.

APPENDIX B

MATERIAL SAFETY DATA SHEETS FOR PRODUCTS

10/25/80

14:00

CEDAR CHEMICAL WORKSHEET DIV.

REV.



VERTAC CHEMICAL CORPORATION

MATERIAL SAFETY DATA SHEET

Section 1		NAME & PRODUCT	IN CASE OF EMERGENCY TELEPHONE
MANUFACTURER'S NAME Brtac Chemical Corporation		For more data, con- sult manufacturer.	1-800-424-9300
STREET ADDRESS 100 Poplar Avenue			
CITY, STATE, ZIP CODE Memphis, TN 38137		Prepared by H. S. Bernard	Date: 5/27/86
CHEMICAL NAME, TRADE NAME AND SYNONYMS oxaphene technical 90%			
FORMULA OF PRIMARY COMPONENTS (STRUCTURAL)			

 $10^H 10^{Cl} 8$ 67-69% chlorine

Section 2		INGREDIENTS	%	TLV (mmHg)
Active Ingredient:		chlorinated camphene	90.0	
Inert Ingredients:		ylene type solvents	10.0	

Section 3		PHYSICAL DATA	
BOILING POINT (BP)	212	1. SPECIFIC GRAVITY (H ₂ O = 1)	1.525
VAPOR PRESSURE (mmHg at 20°C)	1	2. % VOLATILE BY VOLUME	10 @ 100°C
VAPOR DENSITY (air = 1)	N/A	3. COLOR AND ODOR	brown, chlorine
SOLUBILITY IN WATER	1 ppm	4. PHYSICAL STATE	thick liquid

Section 4		FIRE AND EXPLOSION HAZARD DATA	
FLASH POINT (METHOD USED)	212°F. TCC	11. FLAMMABLE LIMITS BY L.F.L. N/D	H.F.L. N/D
EXTIN- GUISHING MEDIA	WATER <input checked="" type="checkbox"/> FOAM <input type="checkbox"/> ALCOHOL FOAM <input checked="" type="checkbox"/> CO ₂ <input checked="" type="checkbox"/> DRY CHEMICAL <input type="checkbox"/> OTHER		
SPECIAL FIRE FIGHTING PROTECTIVE EQUIPMENT self-contained air supply			

UNUSUAL FIRE AND EXPLOSION HAZARDS
Noxious fumes (hydrogen chloride) produced under fire conditions
Confine water used in fire fighting from entering water supplies.

Section 5		REACTIVITY DATA	
STABILITY	Stable	X	14. CONDITIONS TO AVOID May burn under extreme heat.
	FIRE CONDITIONS		
INCOMPAT- IBILITY	<input type="checkbox"/> WATER <input type="checkbox"/> ACID <input type="checkbox"/> BASE <input type="checkbox"/> CORROSIVE* <input type="checkbox"/> OXIDIZING MATERIAL		
HAZARDOUS DECOMPOSITION PRODUCTS	Hydrogen chloride and others.		

INGESTION

High single dose oral toxicity. LD50 male rats 69 mg/kg.

EYE CONTACT

Moderate irritation may occur.

CONTACT

May cause moderate irritation.

ABSORPTION

Absorbed through skin, high toxicity. LD50 rats 1075 mg/kg.

RELATIONSHIP OR SUGGESTED CONTROL FIGURES

OCGH TLV for toxaphene is 0.5mg/m³

EFFECTS OF OVEREXPOSURE

nausea, depression, convulsions, and death.

FIRST AID PROCEDURES

Eyes: Flush with water 30 minutes. Consult physician. Skin: Wash with soap and water 15 minutes.

Ingestion: Toxic by ingestion. Induce vomiting if victim is alert. Clear airway. Control

convulsions. Contact physician immediately.

Section 7

SPILL OR LEAK PROCEDURES

PRECAUTIONS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Use proper safety equipment. Absorb spill with absorbent, inert material such as oil-sorb.

Wipe area for large spills. Keep out of streams and water supplies.

DISPOSAL METHOD

Dispose of in non-crop areas away from water supplies or in an approved landfill

in accordance with State, Federal, and local regulations.

Section 8

SPECIAL PROTECTION INFORMATION

VENTILATION

LOCAL EXHAUST

SPECIAL

MECHANICAL (General)

OTHER

Required

To control TLV of toxaphene

RESPIRATORY PROTECTION (Specify Type)

None normally needed with adequate ventilation. During spraying use organic vapor respirator

PROTECTIVE CLOTHING

Impermeable gloves, boots, and apron, and clean body-covering clothing.

PROTECTION NOT NORMALLY NECESSARY

SAFETY GLASSES WITHOUT SIDE SHIELDS

SAFETY GLASSES WITH SIDE SHIELDS OR

☒ CHEMICAL WORKERS GOGGLES

GAS TIGHT GOGGLES OR EQUIVALENT

OTHER:

OTHER PROTECTIVE EQUIPMENT

Eye wash fountain and wash facilities at work area.

Section 9

SPECIAL PRECAUTIONS OR OTHER COMMENTS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Do not get in eyes, on skin or on clothing. Keep out of reach of children

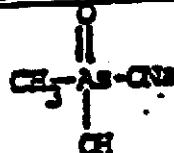
Avoid breathing spray mists or vapors. Keep away from heat or flame.

Extremely toxic to fish. Keep out of streams, lakes, and other bodies of water.

VERTAC CHEMICAL CORPORATION

MATERIAL SAFETY DATA SHEET

Section 1		NAME & PRODUCT	IN CASE OF EMERGENCY TELEPHONE
MANUFACTURER'S NAME Vertac Chemical Corporation		For instant data, copy this manufacturer.	1-800-424-9300
ADDRESS Poplar Avenue		Prepared by: M. S. Bernard	Date: 10/17/84
STATE, ZIP CODE Tn, TN 38137			
CHEMICAL NAME, TRADE NAME AND SYNONYMS Vertac MSA 800, 64/gal Monosodium Acid Methanesulfonate, MSA			
FORMULA OF PRIMARY COMPONENTS (STRUCTURAL)			



Section 2	INGREDIENTS	%	TLV (units)
	Monosodium Acid Methanesulfonate	58.5	
	Water	41.5	

Section 3	PHYSICAL DATA
MELTING POINT (°F)	
VAPOR PRESSURE (mm Hg at 20° C)	Low
VAPOR DENSITY (air = 1)	N/A
SOLUBILITY IN WATER	Miscible
	1. SPECIFIC GRAVITY (H ₂ O = 1) 1.648
	2. % VOLATILE BY VOLUME 40.7
	3. COLOR AND ODOR Very light yellow
	4. PHYSICAL STATE Clear liquid

Section 4	FIRE AND EXPLOSION HAZARD DATA
FLASH POINT (METHOD USED)	U.F.L.
U.F.L.	

WATER SOLUBLE	FOAM	ALCOHOL FOAM	CO ₂	DRY CHEMICAL	OTHER
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

SPECIAL FIRE FIGHTING PROTECTIVE EQUIPMENT
contained breathing apparatus, chemical gloves and boots

ADDITIONAL FIRE AND EXPLOSION HAZARDS
Under EXTREME conditions such as strong acidic environment and strong heat, arsine gas (poisonous gas) may be produced.

Section 5	REACTIVITY DATA
COMPATIBILITY	CONDITIONS TO AVOID Extreme heat and strong acid
FIRE CONDITIONS	
COMPATIBILITY	WATER <input type="checkbox"/> ACID <input type="checkbox"/> BASE <input type="checkbox"/> CORROSIVE <input type="checkbox"/> OXIDIZING MATERIAL <input type="checkbox"/>

Section 6

HEALTH HAZARD DATA

INGESTION

Acute Oral LD50 Rats

1352mg/kg

ACT

Mild Irritant.

ACT

Mild to none irritation, depending on individual's sensitivity.

ABSORPTION

Not absorbed

ENTIRELY OR SUGGESTED CONTROL FIGURES

Not normally a problem

OVEREXPOSURE

Subacute: salty taste, burning in throat, colicky stomach pains, headache, vomiting, diarrhea, stupor, convulsions

PROCEDURES

Eyes: flush with water. Consult physician if irritation persists.

Wash with soap and water. Oral Ingestion: empty stomach by vomiting or

Ind. Lavage with 3 liters isotonic saline. BAL (Dimercaprol) is antidotal;

Repeat in 2mg/kg body weight every 4 hours.

Section 7

SPILL OR LEAK PROCEDURES

TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

spill and transfer to suitable container. Absorb remaining free liquid with

NOTE

METHOD

local pollution control authorities or EPA office.

Section 8

SPECIAL PROTECTION INFORMATION

ACTION

LOCAL EXHAUST

Not normally required

MECHANICAL (General)

SPECIAL

OTHER

PROTECTION (See 4.1.1.1)
ally required

WEAR CLOTHING

Gloves, boots, chemical goggles

ACTION

NORMALLY

☐ SAFETY GLASSES

WITHOUT SIDE SHIELDS

☒ SAFETY GLASSES
WITH SIDE SHIELDS OR☐ CHEMICAL
WORKERS GOGGLES

EQUIPMENT

TIGHT GOGGLES
EQUIVALENT☐ OTHER:

PROTECTIVE EQUIPMENT

required

Section 9

SPECIAL PRECAUTIONS OR OTHER COMMENTS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Standard procedures for chemical handling

PRECAUTIONS

Keep from foods, feeds, seeds, fertilizers, insecticides, and fumigants.

CEDAR CHEMICAL CORPORATION
MEMPHIS, TENNESSEE**MATERIAL SAFETY DATA SHEET**
Equivalent to OSHA form 171

DATE: 08/13 '86 PAGE 1

PRODUCT NAME: TECHNICAL DINOSES
EPA REG. NO.: 56077-3**SECTION I**Manufacturer's Name: Cedar Chemical Corporation
3100 Poplar Ave. 14th Floor
Memphis, TN 38137
Emergency Phone Number: 1-800-424-9300
Information Phone Number: 1-601-636-1231
Prepared by: M. S. Bernard**SECTION II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION**

INGREDIENT	OSHA PEL	ACGIH TLV	PERCENT
Dinoseb	n/d	0.3mg/m ³	95.00
Dinoseb (2-sec-butyl-4,6-dinitrophenol)			
CAS : 88-83-7			
Impurities	n/d	n/d	5.00

SECTION III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point(°F)	above 212	Specific Gravity	1.258
Vapor Pressure(mm Hg.)	below 1	Melting Point(°F)	90
Vapor Density(Air=1)	n/a	Evaporation Rate	n/d
Solubility in Water:	0.0052g/100ml		
Appearance and Odor:	Brown solid. organic acid odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point(Method Used):	350.6°F	TCC
Flammable Limits:	LEL- n/d	UEL- n/d
Extinguishing Media:	Water Fog, Foam, Alcohol Foam, CO ₂ , and Dry Chemical	

Special Fire-Fighting Procedures:

Self-contained air supply. Confine water used in fire fighting.

Unusual Fire and Explosion Hazards:

Noxious fumes may form. Material undergoes rapid exothermic decomposition at 190°C. Vapors may ignite.

SECTION V REACTIVITY DATA

Stability: Stable in normal use and storage.
Conditions to Avoid: Heating above 100°C. Product undergoes rapid exothermic decomposition at 190°C. Avoid ignition sources.
Incompatibility: Strong Bases and Strong Oxidizers
Hazardous Decomposition or Byproducts: Oxides of Nitrogen
Hazardous Polymerization: Will not occur. No known conditions to avoid.

SECTION VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation: Moderate Toxicity
 Skin: Readily Absorbed
 Ingestion: Highly Toxic

Health Hazards (Acute and Chronic):
Oral Ingestion: High Single Dose Oral Toxicity.
 LD₅₀ for Rats 25 mg/kg.
 May be fatal if swallowed.

Eye Contact: May cause severe irritation and corneal injury. Corneal injury should heal in 1-2 weeks.

Skin Contact: May cause slight irritation or mild burn. Colors the skin yellow.

Skin Absorption: Readily absorbed through skin. High toxicity. LD₅₀ rabbits 80mg/kg.

Inhalation: May be irritating. Cedar industrial guide for Dinoseb is 0.3 mg/m³.

Carcinogenicity: NTP: Negative
 IARC Monographs: Negative
 OSHA Regulated: Negative.

Signs and Symptoms of Exposure: Fatigue, sweating, thirst, and fever. Increased metabolic rate.

Medical Conditions Generally Aggravated by Exposure: Liver and kidney problems may be aggravated by extreme exposure.

CEDAR CHEMICAL CORPORATION MEMPHIS, TENNESSEE

MATERIAL SAFETY DATA SHEET Equivalent to OSHA form 174

DATE: 4/20/89 PAGE 1

PRODUCT NAME: POTATO TOP KILLER 300

SECTION I

Manufacturer's Name: Cedar Chemical Corporation
5100 Poplar Ave. 24th Floor
Memphis, TN 38137, USA

Information Phone No.: 1-601-636-1231
Emergency Phone No.: 1-800-424-9300
Prepared by: M. S. Bernard

SECTION II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

INGREDIENTS	OSHA PEL	ACGIH TLV	PERCENT
Dinoseb (2-sec-butyl-4,6-dinitrophenol)	n/d	0.3mg/m ³	30.2
CAS # 88-85-78	200ppm	100ppm	
Toluene			
CAS # 108-88-3			

SECTION III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point(°F)	above 212	Specific Gravity	approx 0.990	Vapor Density(Air=1)	n/d
Vapor Pressure(mmHg.)	below 20	Evaporation Rate	n/d	Melting point	n/d
Solubility in Water:	Insoluble				
Appearance and Odor	Brown liquid. Organic acid odor.				

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point(Method Used): 34°F TCC
 Flammable Limits: LEL- n/d UEL- n/d
 Extinguishing Media: Water Fog, Foam, CO₂, and Dry Chemical
 Special Fire Fighting Procedures: Self contained air supply recommended. Confine water used in fire fighting.
 Unusual Fire and Explosion Hazards: Noxious fumes (Oxides of Nitrogen) may form. Vapors may ignite. Dinoseb undergoes rapid exothermic decomposition at 190°C.

SECTION V REACTIVITY DATA

Stability: Stable in normal use and storage.
 Conditions to Avoid: Heating above 100°C. Avoid ignition sources. Product undergoes rapid exothermic decomposition at 190°C.
 Incompatibility: Strong Acids and Strong Oxidizers.
 Hazardous Decomposition By-products: Oxides of Nitrogen.
 Hazardous Polymerization: Will not occur. No known conditions to avoid.

SECTION VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation: Moderate Toxicity
 Skin: Slightly Toxic
 Ingestion: Readily Absorbed

Emergency and First Aid Procedures:
Oral ingestion: Toxic by ingestion. Induce vomiting and seek medical help immediately.
Eye Contact: Flush immediately with continuous irrigation with flowing water for at least thirty minutes. Seek medical consultation immediately.
Skin Contact: Immediately flush skin with plenty of water for at least fifteen minutes while removing contaminated clothing. Consult physician. Wash clothing before reuse.
Inhalation: Remove to fresh air if effects occur. Consult physician.

Note to Physician:
Eyes: Stain for evidence of corneal injury. If cornea is burned, instill antibiotic steroid preparation frequently. Consult ophthalmologist. May cause temporary injury.
Overexposure: Treat for symptoms. No specific antidote.
Human effects not established.

SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to Be Taken in Case Material is Released or Spilled:
 Use proper safety equipment. Absorb spill with absorbant inert material such as oil-dry. Dike area for large spills. Keep out of streams and water supplies.

Waste Disposal Method:
 Dispose of in non-crop area away from water supplies or in an approved landfill in accordance with State, Federal, and local regulations.

Precautions to Be Taken in Handling and Storing:
 Do not get on skin, on clothing, or in eyes. Keep out of reach of children.

Other Precautions:
 Do not breathe spray mists. Keep away from heat or flame.

SECTION VIII CONTROL MEASURES

Respiratory Protection:
 None normally needed. During spraying use organic vapor respirator.

Ventilation: Required to control level of dinoseb.

Protective Gloves: Impervious rubber gloves

Eye Protection: Chemical workers' goggles

Other Protective Clothing or Equipment: Rubber boots and apron and body-covering clothing.

Work/Hygenic Practices: Shower after handling.

THE INFORMATION HEREIN IS SUPPLIED IN GOOD FAITH.
 NO WARRANTY OR IMPLIED. IS MADE.

Chemical Name

Common Name

Manufacturer

CEDAR CHEMICAL CORPORATION
MEMPHIS, TENNESSEE

MATERIAL SAFETY DATA SHEET
Equivalent to OSHA form 174

PRODUCT NAME: PREMERGE 3
EPA REG. NO.: 56077-13

DATE: 08/15/86 PAGE 1

SECTION I

Manufacturer's Name: Cedar Chemical Corporation
5100 Poplar Ave. 24th Floor
Memphis, TN 38137
Emergency Phone Number: 1-800-424-9300
Information Phone Number: 1-601-636-1231
Prepared by: M. S. Bernard

SECTION II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

INGREDIENT	OSHA PEL	ACGIH TLV	PERCENT
Dinoseb Alkanolamine Salts	n/d	0.3mg/m ³	50.70
Dinoseb (2-sec-butyl-4,6-dinitrophenol)			
CAS # 88-85-7			
	200ppm	200ppm	15.00
Methanol			
CAS # 67-56-1			

SECTION III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point(°F)	above 212	Specific Gravity	1.130
Vapor Pressure(mm Hg.)	50	Melting Point(°F)	n/a
Vapor Density(Air=1)	n/a	Evaporation Rate	n/d
Solubility in Water:	Infinite		
Appearance and Odor:	Brown liquid. sweet alcohol odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point(Method Used): 85°F TCC
Flammable Limits: LEL- n/d UEL- n/d
Extinguishing Media:
Water Fog. Foam. Alcohol Foam. CO₂. and Dry Chemical

CONTINUED ON PAGE 2

POTATO TOP KILLER

Page 2

Health Hazards(Acute and Chronic): Oral Ingestion: High single dose toxicity.
 Acute Oral LD₅₀ (rats) 58 mg/kg for Dinoseb.
 Eye Contact: May cause severe irritation and corneal injury.
 Corneal injury should heal in 1-2 weeks.
 Skin Contact: May cause slight irritation or mild burn.
 Stains skin yellow.
 Skin Absorption: Readily absorbed through skin. Highly toxic.
 Dermal LD₅₀ (guinea pigs) 100-200 mg/kg for Dinoseb.
 Inhalation: May be irritating. Control vapor or dust levels to recommended levels for Dinoseb and Toluene.

Carcinogenicity: NTP: Negative
 IARC Monographs: Negative

OSHA Regulated: Negative

Signs and symptoms of Exposure: Yellow stained skin. Increased body temperature and metabolic rate.
 fatigue, sweating, and thirst.

Medical Conditions Generally Aggravated by Exposure: None known.

Emergency and First Aid Procedures:

Oral Ingestion: Toxic by ingestion. Induce vomiting then give 2 teaspoons of baking soda in water and seek medical help immediately.

Eye Contact: Flush immediately with continuous irrigation of water for at least 30 min. Seek medical consultation immediately. Stain for evidence of corneal injury. Treat if injured by instilling antibiotic steroid preparation frequently.

Skin Contact: Promptly wash skin with plenty of soap and water for at least 15 min. while removing contaminated clothing. Consult physician. Wash clothing before reuse.

Inhalation: Remove to fresh air if effects occur. Consult physician.

NOTE TO PHYSICIAN: No known antidote. Treat symptomatically. Keep patient quiet in cool place. If feverish, cool with cold compresses or by immersion in cool water.

SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps To Be Taken In Case Material Is Released or Spilled:

Use proper safety equipment. Sweep-up material with the aid of an inert absorbent material such as oil-dry. Keep out of streams and water supplies. Contact Chemtec for assistance.

Waste Disposal Methods:

Incineration is recommended. Check with regulatory authorities for landfill disposal regulations.

Precautions To Be Taken In Handling and Storage:

Do not get on skin, on clothing, or in eyes. Keep out of reach of children.

Other Precautions:

Avoid breathing vapors. Keep away from flame.

SECTION VIII CONTROL MEASURES

Respiratory Protection: None normally needed. During use and handling use dust mask or respirator as conditions warrant.

Ventilation: Recommended to control TLV of Dinoseb and Toluene.

Protective Gloves: Intersperse rubber gloves.

Eye Protection: Chemical worker's goggles or full face shield.

Protective Clothing or Footwear: Coveralls, apron, and shoe-covering clothing.

PREMERGE 3 PAGE 2

Special Fire Fighting Procedures:
Self-contained air supply. Confine water used in fire fighting.
Unusual Fire and Explosion Hazards:
Noxious fumes may form. Material undergoes rapid exothermic decomposition at 190°C. Vapors may ignite.

SECTION V. REACTIVITY DATA

Stability: Stable in normal use and storage.
Conditions to Avoid: Heating above 100°C. Product undergoes rapid exothermic decomposition at 190°C. Avoid ignition sources.
Incompatibility: Strong Acids and Strong Oxidizers
Hazardous Decomposition or Byproducts: Oxides of Nitrogen
Hazardous Polymerization: Will not occur. No known conditions to avoid.

SECTION VI. HEALTH HAZARD DATA

Route(s) of Entry: Inhalation: Moderate Toxicity
Skin: Readily Absorbed
Ingestion: Highly Toxic

Health Hazards (Acute and Chronic):

Oral Ingestion: Moderate Single Dose Oral Toxicity.
LD₅₀ Male Rats 170 mg/kg. Female Rats 130 mg/kg. May be fatal if swallowed. May cause blindness.

Eye Contact: May cause severe irritation and corneal injury, possible permanent impairment of vision.

Skin Contact: May cause slight irritation, colors skin yellow.

Skin Absorption: Readily absorbed through skin. high toxicity.

Inhalation: May be irritating. Cedar industrial guide for Dinoseb is 0.3 mg/m³.
ACGIH TLV for methanol is 200ppm.

Carcinogenicity: NTP: Negative
IARC Monographs: Negative
OSHA Regulated: Negative

Signs and Symptoms of Exposure: Fatigue, sweating, thirst, and fever (due to Dinoseb) plus optic nerve injury and blindness. CNS depression, drunkenness, nausea, anesthesia, and vomiting (due to methanol).
Medical Conditions Generally Aggravated by Exposure: Liver and kidney problems may be aggravated by extreme exposure.

Emergency and First Aid Procedures:
Oral Ingestion: Toxic by ingestion. Induce vomiting and seek medical help immediately.
Eye Contact: Flush immediately with continuous irrigation with flowing water for at least thirty minutes. Seek medical consultation immediately.
Skin Contact: Immediately flush skin with plenty of water for at least fifteen minutes while removing contaminated clothing. Consult physician. Wash clothing before reuse.
Inhalation: Remove to fresh air if effects occur. Consult physician.

Note to Physician:
Eyes: Stain for evidence of corneal injury. If cornea is burned, instill antibiotic steroid preparation frequently. Consult ophthalmologist. May cause impairment of vision.
Overexposure: Treat for symptoms. No specific antidote.
Human effects not established.

SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to Be Taken in Case Material is Released or Spilled:
 Use proper safety equipment. Absorb spill with absorbant inert material such as oil-dry. Dike area for large spills. Keep out of streams and water supplies.

Waste Disposal Method:
 Dispose of in non-crop area away from water supplies or in an approved landfill in accordance with State, Federal, and local regulations.

Precautions to Be Taken in Handling and Storing:
 Do not get on skin, on clothing, or in eyes. Keep out of reach of children.

Other Precautions:
 Do not breathe spray mists. Keep away from heat or flame.

SECTION VIII CONTROL MEASURES

Respiratory Protection:
 None normally needed. During spraying use organic vapor respirator.

Ventilation: Required to control TLV of methanol.

Protective Gloves: Impervious rubber gloves

Eye Protection: Chemical workers' goggles

Other Protective Clothing or Equipment: Rubber boots and apron and body-covering clothing.

Work/Hygenic Practices: Shower after handling.

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10/26/90

14:05

CEDAR CHEMICAL VICKSBURG DIV.

813

CEDAR CHEMICAL CORPORATION
MEMPHIS, TENNESSEE

MATERIAL SAFETY DATA SHEET
Equivalent to OSHA form 174

PRODUCT NAME: **PREMERGE PLUS**
EPA REG. NO.: **56077-16**

DATE: **08/15/86** PAGE **1****SECTION I**

Manufacturer's Name: **Cedar Chemical Corporation**
5100 Poplar Ave. 24th Floor:
Memphis, TN 38137
Emergency Phone Number: **1-800-424-9300**
Information Phone Number: **1-601-636-1231**
Prepared by: **M. S. Bernard**

SECTION II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

INGREDIENT	OSHA PEL	ACGIH TLV	PERCENT
Dinoseb Sodium Salt	n/d	0.3mg/m ³	11.50
Dinoseb (2-sec-butyl-4,6-dinitrophenol)			
CAS # 88-85-7			
Naptalam Sodium Salt	n/d	n/d	22.30
Naptalam (N-1-naphthylphthalamic acid)			
CAS # 132-66-1			

SECTION III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point(°F)	188	Specific Gravity	1.150
Vapor Pressure(mm Hg.)	12.	Melting Point(°F)	n/a
Vapor Density(Air=1)	n/a	Evaporation Rate	0.24
Solubility in Water:	Infinite		
Appearance and Odor:	Brown liquid, sweet odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point(Method Used): **above 212°F** TCC
Flammable Limits: **LEL- n/d** UEL- **n/d**
Extinguishing Media:
Water Fog, Foam, Alcohol Foam, CO₂, and Dry Chemical

CONTINUED ON PAGE 2

Special Fire Fighting Procedures:
 Self-contained air supply. Confine water used in fire fighting.
Unusual Fire and Explosion Hazards:
 Noxious fumes may form. Dinoseb undergoes rapid exothermic decomposition at 190°C. Vapors may ignite.

SECTION V REACTIVITY DATA

Stability: Stable in normal use and storage.
Conditions to Avoid: Heating above 100°C. Dinoseb undergoes rapid exothermic decomposition at 190°C. Avoid ignition sources.
Incompatibility: Strong Acids and Strong Oxidizers
Hazardous Decomposition or Byproducts: Oxides of Nitrogen
Hazardous Polymerization: Will not occur. No known conditions to avoid.

SECTION VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation: Moderate Toxicity
 Skin: Absorbed
 Ingestion: Moderate Toxicity

Health Hazards (Acute and Chronic):
Oral Ingestion: Moderate Single Dose Oral Toxicity.
 LD₅₀ Male Rats 232 mg/kg.
 May be fatal if swallowed.
Eye Contact: May cause moderate irritation and non-permanent corneal injury.
Skin Contact: May cause slight irritation. stains skin yellow.
Skin Absorption: Readily absorbed through skin. moderate toxicity. LD₅₀ Rabbits above 400mg/kg.
Inhalation: May be irritating. Cedar industrial guide for Dinoseb is 0.3 mg/m³.
Carcinogenicity: NTP: Negative
 IARC Monographs: Negative
 OSHA Regulated: Negative

Signs and Symptoms of Exposure:
 Yellow staining of skin. profuse sweating. thirst. fever. excessive fatigue. and hypothermia.

Medical Conditions Generally Aggravated by Exposure:
 Liver and kidney problems may be aggravated by extreme exposure.

Chemical Name

Common Name

Manufacturer

CEDAR CHEMICAL CORPORATION
MEMPHIS, TENNESSEE

MATERIAL SAFETY DATA SHEET
Equivalent to OSHA form 174

PRODUCT NAME: SELECTIVE WEED KILLER
EPA REG. NO.: 56077-11

DATE: 08/15/86 PAGE 1

SECTION I

Manufacturer's Name: Cedar Chemical Corporation
5100 Poplar Ave. 24th Floor
Memphis, TN 38137
Emergency Phone Number: 1-800-424-9300
Information Phone Number: 1-601-636-1231
Prepared by: M. S. Bernard

SECTION II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

INGREDIENT	OSHA PEL	ACGIH TLV	PERCENT
Dinoseb Ammonium Salt	n/d	0.3mg/m ³	13.70
Dinoseb (2-sec-butyl-4,6-dinitrophenol)			
CAS # 88-85-7			
Isopropanol	400ppm	400ppm	
CAS # 67-56-1			

SECTION III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point(°F)	175	Specific Gravity	0.860
Vapor Pressure(mm Hg.)	35	Melting Point(°F)	n/a
Vapor Density(Air=1)	n/a	Evaporation Rate	n/d
Solubility in Water:	Infinite		
Appearance and Odor:	Brown liquid. alcohol odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point(Method Used): 66°F TCC
Flammable Limits: LEL- n/d UEL- n/d
Extinguishing Media:
Water Fog, Foam, Alcohol Foam, CO₂, and Dry Chemical

CONTINUED ON PAGE 2

Emergency and First Aid Procedures:
Oral Ingestion: Toxic by ingestion. Induce vomiting and seek medical help immediately.
Eye Contact: Flush immediately with continuous irrigation with flowing water for at least thirty minutes. Seek medical consultation immediately.
Skin Contact: Immediately flush skin with plenty of water for at least fifteen minutes while removing contaminated clothing. Consult physician. Wash clothing before reuse.
Inhalation: Remove to fresh air if effects occur. Consult physician.

Note to Physician:
Eyes: Stain for evidence of corneal injury. If cornea is burned, instill antibiotic steroid preparation frequently. Consult ophthalmologist.
Overexposure: Treat for symptoms. No specific antidote.
Human effects not established.

SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to Be Taken in Case Material Is Released or Spilled:
Use proper safety equipment. Absorb spill with absorbant inert material such as oil-dry. Dike area for large spills. Keep out of streams and water supplies.

Waste Disposal Method:
Dispose of in non-crop area away from water supplies or in an approved landfill in accordance with State, Federal, and local regulations.

Precautions to Be Taken in Handling and Storing:
Do not get on skin, on clothing, or in eyes. Keep out of reach of children.

Other Precautions:
Do not breathe spray mists. Keep away from heat or flame.

SECTION VIII CONTROL MEASURES

Respiratory Protection:
None normally needed. During spraying use organic vapor respirator.

Ventilation: Required to control vapor levels to guidelines.

Protective Gloves: Impervious rubber gloves

Eye Protection: Chemical workers' goggles

Other Protective Clothing or Equipment: Rubber boots and apron and body-covering clothing.

Work/Hygenic Practices: Shower after handling.

THE INFORMATION HEREIN IS SUPPLIED IN GOOD FAITH.
BUT NO WARRANTY, EXPLICIT OR IMPLIED, IS MADE.

SELECTIVE WEED KILLER PAGE 2

Special Fire Fighting Procedures:

Self-contained air supply. Confine water used in fire fighting.

Unusual Fire and Explosion Hazards:

Noxious fumes may form. Material undergoes rapid exothermic decomposition at 190°C. Vapors may ignite.

SECTION V REACTIVITY DATA

Stability: Stable in normal use and storage.

Conditions to Avoid: Heating above 100°C. Product undergoes rapid exothermic decomposition at 190°C. Avoid ignition sources.

Incompatibility: Strong Acids and Strong Oxidizers

Hazardous Decomposition or Byproducts: Oxides of Nitrogen

Hazardous Polymerization: Will not occur. No known conditions to avoid.

SECTION VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation: Moderate Toxicity
Skin: Readily Absorbed
Ingestion: Moderate Toxicity

Health Hazards (Acute and Chronic):

Oral Ingestion: Moderate Single Dose Oral Toxicity.
LD₅₀ Male Rats 205 mg/kg. Female Rats 178 mg/kg. May be fatal if swallowed.

Eye Contact: May cause moderate irritation and corneal injury.

Skin Contact: May cause slight irritation. colors skin yellow.

Skin Absorption: Readily absorbed through skin. moderate toxicity. LD₅₀ Rabbits 212mg/kg.

Inhalation: May be irritating. Cedar industrial guide for Dinoseb is 0.3 mg/m³.
ACGIH TLV for isopropanol is 400ppm.

Carcinogenicity: NTP: Negative
IARC Monographs: Negative
OSHA Regulated: Negative

Signs and Symptoms of Exposure: Yellow staining of skin. profuse sweating. thirst. fever. excessive fatigue. and hypothermia.

Medical Conditions Generally Aggravated by Exposure: Liver and kidney problems may be aggravated by extreme exposure.

SELECTIVE WEED KILLER PAGE 3

Emergency and First Aid Procedures:
Oral Ingestion: Toxic by ingestion. Induce vomiting and seek medical help immediately.
Eye Contact: Flush immediately with continuous irrigation with flowing water for at least thirty minutes. Seek medical consultation immediately.
Skin Contact: Immediately flush skin with plenty of water for at least fifteen minutes while removing contaminated clothing. Consult physician. Wash clothing before reuse.
Inhalation: Remove to fresh air if effects occur. Consult physician.

Note to Physician:

Eyes: Stain for evidence of corneal injury. If cornea is burned, instill antibiotic steroid preparation frequently. Consult ophthalmologist.
Overexposure: Treat for symptoms. No specific antidote.
Human effects not established.

SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to Be Taken in Case Material is Released or Spilled:
Use proper safety equipment. Absorb spill with absorbant inert material such as oil-dry. Dike area for large spills. Keep out of streams and water supplies.

Waste Disposal Method:

Dispose of in non-crop area away from water supplies or in an approved landfill in accordance with State, Federal, and local regulations.

Precautions to Be Taken in Handling and Storing:

Do not get on skin, on clothing, or in eyes. Keep out of reach of children.

Other Precautions:

Do not breathe spray mists. Keep away from heat or flame.

SECTION VIII CONTROL MEASURES**Respiratory Protection:**

None normally needed. During spraying use organic vapor respirator.

Ventilation: Required to control vapor levels to guidelines.

Protective Gloves: Impervious rubber gloves

Eye Protection: Chemical workers' goggles

Other Protective Clothing or Equipment: Rubber boots and apron and body-covering clothing.

Work/Hygenic Practices: Shower after handling.

THE INFORMATION HEREIN IS SUPPLIED IN GOOD FAITH.
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CIBA-GEIGY

MATERIAL SAFETY DATA SHEET

CIBA-GEIGY Corporation
Agricultural Division
Post Office Box 18300
Greensboro, NC 27419

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In Case of Emergency, Call
CIBA-GEIGY: 1-800-888-8372
1-800-334-9481
CHEMTREC: 1-800-424-9300

I. MATERIAL IDENTIFICATION

Product Name: Atrazine Technical

CAS #: 1912-24-9

Active Ingredient (X): 97.0
Chemical Name: 2-chloro-4-ethylamino-6-isopropylamino-s-triazine
Chemical Class: Triazine Herbicide
EPA Signal Word: Caution

II. REGULATORY INFORMATION

SARA Title III Classification
Acute and Chronic Health Hazard

Proposition 65 (CA Only)
Not Determined

Reportable Quantity (RQ)
None

RCRA Classification
Not Applicable

DOT Classification
No Label or Placard Required

H/L Freight Classification
Compound, Weed Killing (Herbicide), N.O.S.

NFPA Hazard Ratings

Health	2
--------	---

Flammability	1
--------------	---

Reactivity	0
------------	---

0 Least	
1 Slight	
2 Moderate	
3 High	
4 Severe	

III. HAZARDOUS INGREDIENTS

Material	OSHA PEL	ACGIH TLV	NTP/IARC/OSHA Carcinogen
Atrazine	5 mg/m ³	5 mg/m ³	
Cyanazine			

IV. FIRST AID PROCEDURES

If poisoning is suspected, immediately contact a physician, the nearest hospital, or the nearest Poison Control Center. Tell the person contacted the complete product name, and the type and amount of exposure. Describe any symptoms and follow the advice given.

Ingestion: If victim is fully conscious, give 1 or 2 glasses of water to drink and induce vomiting. Never give anything by mouth to an unconscious person.

- Eye Contact:** Immediately rinse eyes with a large amount of running water. Hold eyelids apart to rinse the entire surface of the eye and lids. Do not apply any medicating agents except on the advice of a physician.
- Skin Contact:** Wash with plenty of soap and water, including hair and under fingernails. Do not apply any medicating agents except on the advice of a physician. Remove contaminated clothing and wash before reuse.
- Inhalation:** Move victim from contaminated area to fresh air. Apply artificial respiration if necessary.

Notes to Physician

There is no specific antidote if atrazine is ingested. Induce emesis or lavage stomach. If a small amount has been ingested, administration of activated charcoal in water can be considered.

Based on the acute oral LD₅₀ in rats, ingestion of 1/4 pound may be fatal to an adult human.

Medical Conditions Likely to be Aggravated by Exposure

Persons with allergy history or pre-existing dermatitis should use extra precautions in handling atrazine.

V. HEALTH HAZARD INFORMATION

Symptoms of Acute Exposure

Slight, temporary, eye or skin irritation may occur. Repeated skin contact may cause a sensitization (allergic) reaction in sensitive individuals.

Acute Toxicity/Irritation Studies

Ingestion: slightly toxic
Oral LD₅₀ (Rat) = 1,869 mg/kg body weight

Dermal Absorption: slightly toxic
Dermal LD₅₀ (Rat) = >3,100 mg/kg body weight

Inhalation: moderately toxic
Inhalation LC₅₀ (Rat) = >0.71* mg/l air - 1 hour; 1.3* mg/l air - 4 hours (90% atrazine formulation)

*Highest attainable concentrations; no animal deaths or symptoms occurred.

Eye Contact: slightly irritating (Rabbit)

Skin Contact: slightly irritating (Rabbit)

Skin Sensitization: sensitizer (Guinea Pig)

Physical Properties

Appearance:	White Powder
Odor:	Odorless
Melting Point:	175-177°C
Solubility in H ₂ O:	33 ppm @ 22°C
Boiling Point:	Not Applicable
Specific Gravity:	1.19 @ 25°C
Vapor Pressure:	6.6 X 10 ⁻⁷ mm Hg @ 25°C
pH:	Not Available
Evaporation Rate:	Not Applicable

Unusual Fire, Explosion and Reactivity Hazards
Presents a possible dust explosion hazard.

VIII. ENVIRONMENTAL PROTECTIONIn Case of Spill or Leak

Wear chemical safety glasses or goggles, rubber gloves, impervious boots, long-sleeved shirt, long pants, hat, and dust mask. For small spills, sweep up as much material as possible, keeping dust to a minimum, and place in an approved chemical waste container. Wash the spill area with water containing a strong detergent, absorb with pet litter or other absorbent material, sweep up and place in a chemical waste container. Seal container and dispose of in an approved manner. Rinse the spill area with water to remove any residue. Do not allow wash or rinse water to contaminate water supplies.

In Case of Fire

Use dry chemical, foam, or CO₂ extinguishing media. Wear full protective clothing and self-contained breathing apparatus. Evacuate nonessential personnel from the area to prevent human exposure to fire, smoke, fumes, or products of combustion. Prevent use of contaminated buildings, area, and equipment until decontaminated.

Disposal

Do not reuse product containers. Dispose of product containers, waste containers, and residues according to local, state, and federal health and environmental regulations.

Questions concerning the safe handling of Atrazine Technical should be referred to:

CIBA-GEIGY Corporation
Environmental Safety & Compliance
(919) 292-7100

Issued Date: 11/23/85
Revised Date: 2/06/89

Supersedes: 3/09/88

The information and recommendations contained herein are based upon data believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

Chronic Toxicity Studies

Long-term exposure to low levels of atrazine is not known to cause any chronic ill effects in humans.

An elevated incidence of mammary tumors was observed in female Sprague-Dawley rats during a long-term feeding study with Atrazine Technical. This response did not occur in male rats or mice and is considered to be sex- and strain-specific. In other long-term feeding studies, very high doses of atrazine caused signs of cardiotoxicity in dogs and mice. Atrazine caused no adverse reproductive effects over two generations of rats and was not teratogenic in rats or rabbits. Atrazine has been reported to cause mutagenic effects in barley seeds and corn plants, however those findings have been successfully refuted, and data from studies documented as reliable in determining mutagenic potential indicate that atrazine is not a mutagen.

A metabolite of atrazine, 2,3-diamino-6-chloro-1-triazine (DACT), has caused signs of cardiotoxicity in dogs at high doses.

Toxicity of Other Components

Atrazine Technical may contain a very small amount (1.0% or less) of cyanazine as a process-related impurity. Cyanazine has been determined to cause birth defects (teratogenicity) in rats and rabbits at high dose levels.

VI. PERSONAL PROTECTION AND PRECAUTIONS

- Ingestion:** Store the material in a well-ventilated, secure area out of the reach of children and domestic animals. Do not store food, beverages, or tobacco products in the storage area. Prevent eating, drinking, tobacco usage, and cosmetic application in areas where there is a potential for exposure to the material. Always wash thoroughly after handling.
- Eye Contact:** To avoid eye contact, wear chemical safety glasses or goggles.
- Skin Contact:** To avoid skin contact, wear rubber gloves, impervious boots, long-sleeved shirt, long pants, and hat.
- Inhalation:** To avoid breathing dust, wear a dust mask.

VII. PHYSICAL HAZARD INFORMATION

Fire and Explosion

Flash Point (Test Method):	>200°C (Pensky-Martens CC)
Flammable Limits (% in Air):	Not Applicable
Autoignition Temperature:	480°C

Reactivity

Stability:	Stable
Hazardous Polymerization:	Will Not Occur
Conditions to Avoid:	None Known

Hazardous Decomposition
Products:

May Include Carbon Monoxide, Hydrogen Cyanide,
Acetonitrile

APPENDIX C

**PUBLISHED EPA HEALTH BASED ACTION LEVELS, IRIS PRINTOUT AND
HEAST TABLE ON ATRAZINE AND OSWER DIRECTIVE 9355.0-30**

Table 8-7. (continued)¹

Constituent	CAS No.	RfD ² (mg/kg/day)	Soil (mg/kg)	Water (ug/l)	Air (ug/m ³)
Dichlorodifluoromethane	75-71-8	2E-01	2E-04	7E-03	-
1,1-Dichloroethylene	75-35-4	9E-03	7E-02	See MCL	-
Dichloromethane (Methylene chloride)	75-09-3	6E-02	9E-03	2E-03	-
2,4-Dichlorophenol	120-83-2	3E-03	2E-02	1E-02	1E-01
1,3-Dichloropropene	26952-22-8	3E-04	2E-01	1E-01	-
Dieldrin	60-57-1	5E-05	4E-00	2E-00	-
Diethyl phthalate	84-66-2	8E-01	6E-04	3E-04	-
Dimethoate	60-51-8	2E-02	2E-03	7E-02	-
2,4-Dinitrophenol	51-28-5	2E-03	2E-02	7E-01	7E-00
Dinoseb	88-85-7	1E-03	8E-01	4E-01	-
Diphenylamine	127-39-4	3E-02	2E-03	1E-03	-
Disulfoton	298-04-4	4E-05	3E-00	1E-00	-
Endosulfan	115-29-7	5E-05	4E-00	2E-00	2E-01
Endothal	145-73-3	2E-02	2E-03	7E-02	-
Endrin	72-20-8	3E-04	2E-01	See MCL	1E-00
Ethylbenzene	100-41-4	1E-01	8E-03	4E-03	-
Heptachlor	76-14-8	5E-04	4E-01	2E-01	-
Heptachlor epoxide	1024-57-8	1E-05	8E-01	4E-01	-
Hexachlorobutadiene	87-68-3	2E-03	2E-02	7E-01	-
Hexachlorocyclopentadiene	77-47-4	7E-03	6E-02	2E-02	-
Hexachloroethane	67-72-1	1E-03	8E-01	4E-01	-
Hydrogen cyanide	74-90-8	2E-02	2E-03	7E-02	-
Hydrogen sulfide	7783-06-4	3E-03	2E-02	1E-02	-
Isobutyl alcohol	78-83-1	3E-01	2E-04	1E-04	1E-03
Isophorone	78-59-1	2E-01	2E-04	7E-03	-
Limeane (hexachlorocyclohexane)	58-89-9	3E-04	2E-01	See MCL	-
Maleic hydrazide	108-31-6	5E-01	4E-04	2E-04	-
Methacrylonitrile	126-98-7	1E-04	8E-00	4E-00	-
Methomyl	16752-77-5	3E-02	2E-03	1E-03	-
Methyl ethyl ketone	78-93-3	5E-02	4E-03	2E-03	-
Methylisobutyl ketone	108-10-01	5E-02	4E-03	2E-03	-

Note: These criteria are subject to change and will be confirmed by the regulatory agency prior to use.

APPENDIX C—RANGE OF CONCENTRATIONS FOR ESTABLISHING MEDIA PROTECTION STANDARDS FOR CARCINOGENS—Continued

Constituent name	Class	MaxAir ($\mu\text{g}/\text{m}^3$)	MinAir ($\mu\text{g}/\text{m}^3$)	MaxWater (mg/L)	MinWater (mg/L)	MaxSoil (mg/kg)	MinSoil (mg/kg)
Styrene	C	1E+01	1E-01	1E-01	2E+00	2E+00	2E-
1,1,1,2-Tetrachloroethane	C	1E+01	1E-01	1E-01	1E-03	2E+00	2E+01
1,2,4,5-Tetrachlorobenzene	C	2E-00	2E-02	2E-02	2E-04	4E+02	4E-00
1,1,1,2-Tetrachloroethane	C	1E+02	1E-00	7E-02	7E-04	1E+00	1E+01
1,1,2,2-Tetrachloroethane	B2						
Tetrachlorobenzene	D						
2,3,4,5-Tetrachlorophenol	D						
Tetraethyl lead	D						
Tetraethylthiopyrophosphate	D						
Thalic acid	D						
Thallium acetate	D						
Thallium carbonate	D						
Thallium chloride	D						
Thallium nitrate	D						
Thallium sulfate	D						
Thioacetamide	D						
Tinane	D						
Toluene	B2	2E-01	2E-03	2E-03	2E-06	6E+01	6E-01
Tosaphene	D						
1,2,4-Trichlorobenzene	D						
1,1,1-Trichloroethane	C	6E-00	6E-02	6E-02	6E-04	1E+03	1E+01
1,1,2-Trichloroethane	B2			2E-01	2E-03	6E+00	6E+01
Trichlorobenzene	D						
Trichloromethylfluoromethane	D						
2,4,6-Trichlorophenol	B2	2E+01	2E-01	2E-01	2E-03	4E+03	4E+01
2,4,6-Trichlorophenol	D						
2,4,6-Trichlorophenoxyacetic acid	D						
1,2,3-Trichloropropene	D						
Vanadium pentoxide	D						
Xylenes	D						
Zinc cyanide	D						
Zinc phosphide	D						

Appendix D: Recommended Exposure Assumptions for Use in Deriving Action Levels

(Sections 264.521 (a)(2); (b); (c)(3); and (d))

1. In deriving action levels for hazardous constituents in ground-water, assume a water intake of 2 liters/day for 70 kg adult/70 year lifetime exposure period.
2. In deriving action levels for hazardous constituents in air, assume air intake of 20 cubic meters/day for 70 kg adult/70 year lifetime exposure period.
3. In deriving action levels for hazardous constituents in soil, which are known or suspected to be carcinogens, assume soil intake of 0.1 gram/day for 70 kg adult/70 year lifetime exposure period.
4. In deriving action levels for hazardous constituents in soil other than those which are known or suspected to be carcinogens, assume soil intake of 0.2 gram/day for 10 kg child/5 year exposure period (age 1-6).^a
5. In deriving action levels for hazardous constituents in surface water designated by the State for use as a drinking water source, assume a water intake of 2 liters/day for 70 kg adult/70 year lifetime exposure period, unless intake of aquatic organisms is also of concern.

^aNot to be averaged over a 70-year lifetime.

Appendix E: Examples of Calculations of Action Levels

I. Governing Equations for Calculating Action Levels

A. Systemic Toxicants

$$C_a = [RD \cdot W] / [I \cdot A]$$

where:

C_a = action level in medium (units are medium-dependent);

RD = reference dose ($\text{mg}/\text{kg}/\text{day}$);

W = body weight (kg);

I = intake assumption (units are medium-dependent); and

A = absorption factor¹ (dimensionless).

B. Carcinogenic Constituents

$$C_a = [R \cdot W \cdot LT] / [CSF \cdot I \cdot A \cdot ED]$$

where:

C_a = action level in medium (units are medium-dependent);

R = assumed risk level (dimensionless) (10^{-6} for class A & B; 10^{-5} for class C carcinogens);

W = body weight (kg);

LT = assumed lifetime (years);

CSF = carcinogenic slope factor ($\text{mg}/\text{kg}/\text{day}$)⁻¹;

I = intake assumption (units are medium-dependent);

A = absorption factor (dimensionless); and

ED = exposure duration (years).

¹ Assumed to be 1 for this appendix, based upon the assumption that the human absorption rate will be the same as the rate in the study upon which the RD or CSF was developed.

II. Example Calculations for Hazardous Constituents in Air

A. Systemic Toxicants

Example calculation for 2,4-dinitrophenol:

$$C_a = [0.002 (\text{mg}/\text{kg}/\text{day}) \cdot 1000 (\mu\text{g}/\text{mg}) \cdot 70 (\text{kg})] / [20 (\text{m}^3/\text{day}) \cdot 1] = 7.0 \mu\text{g}/\text{m}^3$$

where:

C_a = action level in air ($\mu\text{g}/\text{m}^3$)

$RD = 0.002 \text{ mg}/\text{kg}/\text{day}$

$W = 70 \text{ kg adult}$

$I = 20 \text{ m}^3/\text{day}$

$A = 1$

B. Carcinogenic Constituents

Example calculation for 1,1,2,2-tetrachloroethane:

$$C_a = [10^{-6} \cdot 1000 (\mu\text{g}/\text{mg}) \cdot 70 (\text{yr}) \cdot 70 (\text{kg})] / [0.20 (\text{mg}/\text{kg}/\text{day}) \cdot 20 (\text{m}^3/\text{day}) \cdot 1 \cdot 70 (\text{yr})] = 375 \mu\text{g}/\text{m}^3$$

where:

C_a = action level in air ($\mu\text{g}/\text{m}^3$)

$R = 10^{-6}$ (1,1,2,2-Tetrachloroethane is a Class C carcinogen)

$W = 70 \text{ kg adult}$

$LT = 70 \text{ year lifetime}$

$CSF = 0.20 (\text{mg}/\text{kg}/\text{day})^{-1}$

$I = 20 \text{ m}^3/\text{day}$

$A = 1$

$ED = 70 \text{ year exposure duration}$

III. Sample Calculation for Hazardous Constituents in Water

A. Systemic Toxicants

Sample calculation for toluene:

$$C_a = [0.30 (\text{mg}/\text{kg}/\text{day}) \cdot 70 (\text{kg})] / [2 (\text{L}/\text{day}) \cdot 1] = 10.5 \text{ mg}/\text{L}$$

where:

C_a = action level in water (mg/L)

develop and conduct these further Regulatory Impact Analyses.

The new analyses will be conducted in accordance with the existing Agency guidance on Regulatory Impact Analysis and the draft Regulatory Impact Analysis Guidance published in the 1988 Regulatory Program of the United States. The analyses will explicitly examine the costs, health and environmental benefits, and technological limitations for the key regulatory requirements contained in the proposal—especially for the several alternative approaches to ground water remediation outlined in the proposed rule. This analysis will also estimate the aggregate impacts, identified above, for sites eligible for remediation under this rule and for those sites which are listed on the NPL and will, therefore, look to this rule as an ARAR under the provisions of CERCLA. Upon completion of the revised analyses, EPA will solicit comment on the results of the analyses and the methodology used to derive them. The Agency will then assess these comments, along with comments which will have been received previously on the proposed rule. Through these actions EPA will ensure that the net social benefits (including environmental and health benefits) of the rule proposed today are maximized, taking into account costs, technological limitations, risks, and realistic assessments of both actual and reasonably expected uses of each site. If the revised RIA, together with the comments received, demonstrate that the rule proposed today does not achieve this outcome, the Agency will make appropriate

modifications to the final rule, or if necessary, will repropose the rule.

B. Regulatory Flexibility Act

The Regulatory Flexibility Act requires Federal agencies to fully analyze the economic effects of regulations on small entities. The Agency analyzed the economic impacts for the regulatory options that are most similar to today's proposed rule (i.e., "Immediate Cleanup to Health-Based Standards" and "Flexible Cleanup to Health-Based Standards").

The RIA assumes that a small business is significantly impacted if its excess of cash flow over ten percent of its total liabilities is insufficient to meet corrective action costs, or if its net income is insufficient to meet its corrective action costs.

For the alternative analyzed, it was found that small firms encounter more severe impacts from the corrective action requirements than large firms. The options most similar to the proposed rule result in incremental impacts (i.e., relative to the baseline) on approximately 9 to 11 percent of small businesses owning RCRA facilities.

Based on the Agency's guidelines for implementing the Regulatory Flexibility Act, the results of the analysis as summarized above, suggest that the proposed rule does not impose significant impacts on small entities.

C. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget

(OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. Reporting and recordkeeping burden on the public for this collection is estimated at 42,497 hours for the 574 respondents, with an average of 73.1 hours per response. (Burden estimates should include all aspects of the collection effort and may include time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, completing and reviewing the collection of information, etc.)

If you wish to submit comments regarding any aspect of the collection of information, including suggestions for reducing the burden, or if you would like a copy of the information collection request (please reference ICR #1451), contact Rick Westlund, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460 (202-382-2745); and Tim Hunt, Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

List of Subjects in 40 CFR Parts 264, 265, 270, and 271

Administrative practice and procedure, Corrective action, Hazardous waste, Insurance, Reporting and recordkeeping requirements.

Dated: July 5, 1990.

William Reilly,
Administrator.

XI. Supplementary Documents

APPENDIX A—EXAMPLES OF CONCENTRATIONS MEETING CRITERIA FOR ACTION LEVELS (Section 264.221(a)(2)(i)-(v))

Concentrations	Class	Air (ug/ m ³)	Water (mg/L)	Soils (mg/ kg)
Asbestos	D		4E-00	8E+03
Asbestos	D		2E-01	6E+02
Asbestos	D	2E-01	4E-00	6E+03
Asbestos	B2	8E-04	8E-06	2E-01
Asbestos	B1	1E-02	8E-06	1E-00
Asbestos	D		8E-02	1E+02
Asbestos	B2	2E-04	2E-06	4E-02
Asbestos	D		2E-01	4E+02
Asbestos	D		1E-02	3E+01
Asbestos	D		6E-02	1E+02
Asbestos	B2		1E-02	3E+01
Asbestos	A	7E-06	(1)	8E+01
Asbestos	A	2E-02		
Asbestos (2)	D		2E-00	6E+03
Asbestos (2)	D	4E-01	(1)	4E+03
Asbestos (2)	A	2E-06	2E-07	3E-03
Asbestos (2)	B2	4E-04	8E-06	2E-01
Asbestos (2)	B2		3E-03	5E+01
Asbestos (2)	B2	3E-03	3E-06	6E-01
Asbestos (2)	B2		3E-06	5E-01
Asbestos (2)	D		7E-01	2E+03
Asbestos (2)	D	3E+01	5E-02	1E+02
Asbestos (2)	C		7E-00	2E+04

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE 2: CARCINOGENICITY
Update: December, 1990

Compound	Exposure Inhalation; Oral	Species Inhalation Oral		Tumor Site Inhalation Oral		EPA Group/Unit Risk (Slope Factor)		Reference Inhalation/Oral
						Inhalation ($\mu\text{g}/\text{m}^3$) ⁻¹ [($\mu\text{g}/\text{kg}/\text{day}$) ⁻¹]	Oral ($\text{mg}/\text{kg}/\text{day}$) ⁻¹	
Aniline	RA; 2-year dietary	NA	rat	NA	spleen	B2/ND	B2/1.8E-7 [3.7E-3] ^a	U.S. EPA, 1990/ CIT, 1982; U.S. EPA, 1985, 1
Aroclor	RA; 400 ppm in diet for 104 weeks (20 $\text{mg}/\text{kg}/\text{day}$)	NA	rat	increased incidence of liver tumors (also see Table A)	increased incidence of liver tumors	B2/7.1E-6 [2.5E-2] ^b	B2/7.1E-6 [2.5E-2]	Popper et al., 19 Oser and Oser, 19 U.S. EPA, 1979/ Popper et al., 19 Oser and Oser, 11 U.S. EPA, 1989
Arsenic	100-5000 $\mu\text{g}/\text{m}^3$ continuous; 0.01-1.8 mg/L in drinking water	human	human	respiratory tract (also see Table A)	skin	A/4.3E-6 [5.0E+1] ^{c,p}	A/NA ^k	Brown and Chu, 1973a,b,c; Lee- Feldstein, 1983; Biglino, 1981; Zetterline and Hersh, 1982; U.S. EPA, 1984a, 1990/U.S. EPA, 1990
Asbestos	occupational; dietary	human	rat	lung and mesothelium	large intestine	A/2.3E-1 [2.1E+2] ^m	A/ND	U.S. EPA, 1988, 1989/WT, 1983; U.S. EPA, 1985.
Atroline	RA; 2-year dietary	NA	rat	NA	mammary gland adenoma, fibro- adenoma, adeno- carcinoma and sarcomas	C/ND	C/8.3E-6 [2.2E-1] ^e	U.S. EPA, 1984/ Ciba-Geigy, 1984 U.S. EPA, 1984
Benzene	NA; 2-year dietary	NA	rat	NA	abdominal cavity	B1/3.1E-1 [1.1E-1] ^{a,b}	B1/3.1E-6 [1.1E-1] ^a	U.S. EPA, 1989/ NCI, 1978; U.S. 1988, 1990
Benzene	occupational; occupational	human	human	leukemia	leukemia	A/8.3E-6 [2.5E-2] ^a	A/8.3E-7 [2.5E-2] ^{a,b}	Ott et al., 197 Rinsky et al., 19 Wong et al., 19 U.S. EPA, 1983, 1987, 1988, 1989 Ott et al., 197 Rinsky et al., 19 Wong et al., 19 U.S. EPA, 1983, 1987, 1988, 1989

ATTACHMENTS

- **IRIS Printout - Atrazine**
- **HEAST Table - Atrazine**
- **OSWER Directive 9355.0-30**

IRSN - 206
 DATE - 910114
 UPDT - Complete Update on 01/14/91, 52 fields added/edited/deleted.
 STAT - Oral RfD Assessment (RDO) on-line 01/01/91
 STAT - Inhalation RfC Assessment (RDI) no data
 STAT - Carcinogenicity Assessment (CAR) pending
 STAT - Drinking Water Health Advisories (DWHA) no data
 STAT - U.S. EPA Regulatory Actions (EXSR) no data
 IRH - 03/01/88 RDO Confidence levels revised
 IRH - 08/22/88 RDO Withdrawn; new oral RfD in preparation
 IRH - 09/07/88 RDO Revised oral RfD summary added
 IRH - 10/01/89 REFS Bibliography on-line
 IRH - 03/01/90 RDO Withdrawn; new oral RfD in preparation
 IRH - 03/01/90 OREF Oral RfD references withdrawn
 IRH - 05/01/90 RDO Oral RfD summary replaced; RfD unchanged
 IRH - 05/01/90 OREF Oral RfD references replaced
 IRH - 01/01/91 RDO Text edited
 IRH - 01/01/91 CAR Carcinogen assessment now under review
 RLEN - 13131
 NAME - Atrazine
 RN - 1912-24-9
 SY - A 361
 SY - AATREX
 SY - AATREX 4L
 SY - AATREX 80W
 SY - AATREX NINE-O
 SY - 2-ETHYLAMINO-4-CHLOR-6-ISOPROPYLAMINO-1,3,5-TRIAZIN
 SY - 2-ETHYLAMINO-4-ISOPROPYLAMINO-6-CHLOR-1,3,5-TRIAZIN
 SY - AKTIKON
 SY - AKTIKON PK
 SY - AKTINIT A
 SY - AKTINIT PK
 SY - ARGEZIN
 SY - ATAZINAX
 SY - ATRANEX
 SY - ATRASINE
 SY - ATRATOL A
 SY - ATRAZIN
 SY - Atrazine
 SY - ATRED
 SY - ATREX
 SY - CANDEX
 SY - CEKUZINA-T
 SY - 2-CHLORO-4-ETHYLAMINEISOPROPYLAMINE-s-TRIAZINE
 SY - 1-CHLORO-3-ETHYLAMINO-5-ISOPROPYLAMINO-2,4,6-TRIAZINE
 SY - 1-CHLORO-3-ETHYLAMINO-5-ISOPROPYLAMINO-s-TRIAZINE
 SY - 2-CHLORO-4-ETHYLAMINO-6-ISOPROPYLAMINO-1,3,5-TRIAZINE
 SY - 2-CHLORO-4-ETHYLAMINO-6-ISOPROPYLAMINO-s-TRIAZINE
 SY - 6-CHLORO-N-ETHYL-N'-(1-METHYLETHYL)-1,3,5-TRIAZINE-2,4-DIAMINE
 SY - 2-CHLORO-4-(2-PROPYLAMINO)-6-ETHYLAMINO-s-TRIAZINE
 SY - CRISATRINA
 SY - CRISAZINE
 SY - CYAZIN
 SY - FARMCO ATRAZINE
 SY - FENAMIN
 SY - FENAMINE
 SY - FENATROL
 SY - G 30027
 SY - GEIGY 30,027
 SY - GESAPRIM
 SY - GESOPRIM
 SY - GRIFFEX
 SY - HUNGAZIN
 SY - HUNGAZIN PK
 SY - INAKOR

SY - OLEOGESAPRIM
 SY - PRIMATOL
 SY - PRIMATOL A
 SY - PRIMAZE
 SY - RADAZIN
 SY - RADIZINE
 SY - STRAZINE
 SY - TRIAZINE A 1294
 SY - s-TRIAZINE, 2-CHLORO-4-ETHYLAMINO-6-ISOPROPYLAMINO-
 SY - 1,3,5-TRIAZINE-2,4-DIAMINE, 6-CHLORO-N-ETHYL-N'-(1-METHYLETHYL)-
 SY - VECTAL
 SY - VECTAL SC
 SY - WEEDEX A
 SY - WCONUK
 SY - ZEAZIN
 SY - ZEAZINE

RDO -

o ORAL RFD SUMMARY :

Critical Effect	Experimental Doses*	UF	NF	RFD
Decreased body weights of F2 generation pups on postnatal day 21	NOEL: 10 ppm (0.5 mg/kg/day)	100	1	SE-3 mg/kg/day
2-Generation Rat Reproduction Study	LEL: 50 ppm (2.5 mg/kg/day)			

Ciba-Geigy, 1987a

*Conversion Factors: 1 ppm = 0.05 mg/kg/day (assumed rat food consumption)

o ORAL RFD STUDIES :

Ciba-Geigy Corporation. 1987a. MRID No. 40431303.
 Available from EPA. Write to FOI, EPA, Washington, DC 20460.

In a 2-generation reproduction study, 120 rats/sex were randomly distributed into 4 treatment groups and fed atrazine at 0, 10, 50, or 500 ppm (0, 0.5, 2.5, and 25 mg/kg/day). Exposure to the test material began when male rats were 47 days old and females were 48 days old. They were maintained on these diets for 10 weeks prior to mating. Males and females were housed together in a 1:1 ratio and allowed 3 weeks for mating. The rats were separated following evidence of mating. One litter was produced in each generation. After weaning, 30 males and 30 females from the first generation were selected to be the second parental generation. The remaining male parental animals were sacrificed on days 133 to 134 of the study. Animals selected for the second generation were exposed to test diets for 12 weeks prior to mating. Mating was conducted in the same manner as for the first generation. Parental males were sacrificed on day 138 of the study and parental females on days 138, 139, and 152 after weaning of their litters.

The NOEL for reproductive toxicity is 10 ppm (0.5 mg/kg/day) based on statistically significantly lower F2 generation pup weights at postnatal day 21 at 50 and 500 ppm (2.5, and 25 mg/kg/day). The NOEL for parental toxicity is 50 ppm (2.5 mg/kg/day) based on statistically significantly decreased body weights, body weight gain and food consumption for males and females throughout the study at 500 ppm (25 mg/kg/day). In addition, a statistically significant increase in relative testes weights was seen in both generations.

o ORAL RFD UNCERTAINTY :

UF = 100. An uncertainty factor of 100 was used to account for the inter- and intraspecies differences.

MF = 1.

o ORAL RFD COMMENTS :

Data Considered for Establishing the RFD

- 1) 2-Generation Reproduction - rat: see previous description; core grade minimum (Ciba-Geigy Corp., 1987a)
- 2) 1-Year Feeding - dog: Dietary levels tested: 0, 15, 150, and 1000 ppm (Male: 0, 0.48, 4.97, and 33.65 mg/kg/day; Female: 0, 0.48, 4.97, and 33.8 mg/kg/day). NOEL=150 ppm (4.97 mg/kg/day); LEL=1000 ppm (43 mg/kg/day) (NDR; based on death, cachexia, ascites, decreased body weight and body weight gain, decreased food consumption; EKG changes (irregular heart beat and increased heart rate, decrease P-II values, atrial premature complexes, atrial fibrillation); cardiac lesions (dilation of atria, atrial degeneration)); core grade minimum (Ciba-Geigy Corp., 1987b)
- 3) 2-Year Feeding (oncogenic) - rat: Dietary levels tested: 0, 70, 500, and 1000 ppm (0, 3.5, 25, and 50 mg/kg/day). Administration of atrazine to male and female CD-1 Sprague-Dawley rats resulted in decreased mean body weights for males and females receiving 500 and 1000 ppm. Survival was decreased in high-dose females but increased in high-dose males. Red blood cell parameters (hemoglobin, hematocrit, and red cell count) were decreased in high-dose females only. The serum glucose level was decreased in high-dose females at 3, 6, and 12 months and serum triglyceride levels showed a decreasing trend in high-dose males throughout the study. There were decreases in organ-to-body weight ratios in high-dose animals, which were probably the result of body weight decreases. Hyperplastic changes in high-dose males (mammary gland, bladder, and prostate) and females (myeloid tissue of bone marrow and transitional epithelium of the kidney) were of questionable toxicologic importance. There was an increase in retinal degeneration and in centrilobular necrosis of the liver in high-dose females and an increase in degeneration of the rectus femoris muscle in high-dose males and females when compared to controls. Based on decreased body weight gain, the LEL for males and females is 500 ppm (25 mg/kg/day) and the NOEL is 70 ppm (3.5 mg/kg/day); core grade minimum (Ciba-Geigy Corp., 1986)
- 4) Developmental toxicity - rat: Dietary levels tested: 0, 10, 70, and 700 mg/kg/day (by gavage). Administration of atrazine technical to Charles River CD rats from days 6 to 15 of gestation resulted in maternal toxicity during and after the treatment period at the high-dose. Signs of toxicity at the high-dose included death (21 of 27 dams), reduced food consumption, reduced weight gain, salivation, ptosis, swollen abdomen, oral/nasal discharge, and bloody vulva. Maternal toxicity was also found at the 70 mg/kg/day dose level. Toxicity signs in this group included reduced food consumption, reduced body weight, and reduced weight gain. No maternal toxicity was observed in the 10 mg/kg/day or control groups. Based on the above effects, the maternal toxicity NOEL is 10 mg/kg/day and the LEL is 70 mg/kg/day. At 70 mg/kg/day, there were statistically significant increases in both fetal and litter incidences for skeletal variations indicating delayed ossification. Variations included: skull not completely ossified, metacarpals not ossified, metacarpals bipartite, and phalanx not ossified. Based on these effects the NOEL and LEL for developmental toxicity are 10 and 70 mg/kg/day, respectively.; core grade minimum (Ciba-Geigy Corp., 1984a)
- 5) Developmental toxicity - rabbit: Dietary levels tested: 0, 1, 5, 75 mg/kg/day (by gavage). Administration of atrazine technical to New Zealand White rabbits from days 7 to 19 of gestation resulted in maternal toxicity during the treatment period at doses of 5 and 75 mg/kg/day. Does in the 75 mg/kg/day group did not recover from symptoms of this toxicity during the period after dosing. Signs of maternal toxicity in the 5 mg/kg/day dose group were decreased food consumption and decreased body weight. Signs of maternal toxicity in the high-dose group included blood on vulva or in cage, decreased food consumption, abnormal stools, and decreased body weight and body weight gain. No effects were observed at the lowest dose

Based on the above effects, the maternal toxicity NOEL is 1 mg/kg/day and the LEL 5 mg/kg/day. An increased number of resorptions in the HDT was statistically significant and was not observed at any other dose level. In the HDT, the weights of both the male and female fetuses were significantly reduced. No compound-related malformations were observed. Skeletal variations, especially delayed ossification of appendicular skeletal elements, were found more frequently in the HDT. Based on the above effects, the developmental toxicity NOEL is 5 mg/kg/day and the LEL 75 mg/kg/day; core grade minimum (Ciba-Geigy Corp., 1984b)

Other Data Reviewed:

- 1) Chronic Feeding - mouse: Dietary levels tested: 0, 10, 300, 1500, and 3000 ppm (Male: 0, 1.4, 38.4, 194.0, and 385.7 mg/kg/day; Female: 0, 1.6, 47.9, 246.9, and 482.7 mg/kg/day). This study shows that there are dose-related effects of atrazine in CD-1 mice fed diets containing 1500 or 3000 ppm of atrazine. The dose-related effects were the production of cardiac thrombi, decreases of 23.5% and 11.0% in the mean body weight gain at 91 weeks in males and females, respectively, and decreases in erythrocyte count, hematocrit and hemoglobin concentration. An increase in the incidence of cardiac thrombi was found in females receiving 1500 and 3000 ppm. Based on the above effects, the LEL for systemic toxicity is 1500 ppm (Male: 194.0 mg/kg/day; Female: 246.9 mg/kg/day). The NOEL for systemic toxicity is 300 ppm (Male: 38.4 mg/kg/day; Female: 47.9 mg/kg/day).; core grade guideline (Ciba-Geigy Corp., Agricultural Division, 1987c)
- 2) 2-Year Feeding - dog: Dietary levels tested: 0, 14.1, 141.5, and 1415 ppm (0, 0.35, 3.54, and 35.38 mg/kg/day). The NOEL for systemic toxicity is 14.1 ppm (0.35 mg/kg/day) based on increased heart and liver weights in females at 141.5 ppm (3.54 mg/kg/day). Effects observed at 1415 ppm (35.38 mg/kg/day) included reduced food intake, decreased body weight, and reduced hemoglobin and hematocrit values. core grade supplementary (Ciba-Geigy Corp., 1984)
- 3) Developmental toxicity - rat: Dietary levels tested: 0, 100, 500, and 1000 mg/kg/day. Administration of atrazine at 1000 mg/kg/day produced 7 deaths in the 30 dams treated. Slight weight losses in females were observed at 500 mg/kg/day. A reduction in mean fetal weights and an increase in the number of embryonic and fetal resorptions were observed in the mid- and high-dose groups. Based on the above effects, the maternal toxicity and fetotoxicity NOEL and LEL are 100 and 500 mg/kg/day, respectively; core grade minimum (Ciba-Geigy, Corp., 1971)

Data Gap(s): None

o ORAL RFD CONFIDENCE :

Study: High
Data Base: High
RfD: High

The critical study is of good quality and is given a high confidence rating. Additional studies are supportive and of good quality; therefore, the data base is given a high confidence rating. High confidence in the RfD follows.

o ORAL RFD SOURCE DOCUMENT :

The only U.S. EPA documentation at present is on IRIS.

Pesticide Registration Standard

Pesticide Registration Files

o REVIEW DATES : 07/08/86, 12/09/86, 05/20/87, 06/22/88,
02/21/90
o VERIFICATION DATE : 02/21/90

HEALTH EFFECTS ASSESSMENTS SUMMARY TABLE B: CARCINOGENICITY
Update: December, 1990

Compound	Exposure Inhalation; Oral	Species		Tumor Site		EPA Group/Unit Risk (Slope Factor)		Reference Inhalation/Oral
		Inhalation	Oral	Inhalation	Oral	Inhalation	Oral	
						$(\mu\text{g}/\text{m}^3)^{-1}$ $(\text{mg}/\text{kg}/\text{day})^{-1}$	$(\mu\text{g}/\text{l})^{-1}$ $(\text{mg}/\text{kg}/\text{day})^{-1}$	
Aniline	NA; 2-year dietary	NA	rat	NA	spleen	B1/NO	B2/1.8E-7 (5.7E-3) ^a	U.S. EPA, 1990/ CIIT, 1982; U.S. EPA, 1985, 1990
Aranika	NA; 400 ppm in diet for 104 weeks (20 mg/kg/day)	NA	rat	increased incidence of liver tumors (also see Table A)	increased incidence of liver tumors	B2/7.1E-8 (2.5E-2) ^a	B2/7.1E-8 (2.5E-2)	Popper et al., 1980; Oser and Oser, 1982; U.S. EPA, 1988/ Popper et al., 1980; Oser and Oser, 1982; U.S. EPA, 1988
Arsenic	100-5000 $\mu\text{g}/\text{m}^3$ continuous; 0.01-1.8 mg/l in drinking water	human	human	respiratory tract (also see Table A)	skin	A/4.3E-9 (5.8E+1) ^{a,b}	A/NA ^a	Brown and Chu, 1983a,b,c; Lee- Feldstein, 1983; Biggins, 1982; Keterline and Haxah, 1982; U.S. EPA, 1981a,b, 1990/U.S. EPA, 1990
Asbestos	occupational; dietary	human	rat	lung and mesothelioma	large intestine	A/1.2E-1 (fibers/ μm^2) ^{-2a}	A/NO	U.S. EPA, 1988, 1990/NTP, 1985; U.S. EPA, 1985, 1990
Atrazine	NA; 2-year dietary	NA	rat	NA	mammary gland adenoma, fibro- adenomas, adeno- carcinomas and carcinomas	C/NO	C/0.3E-8 (2.2E-1) ^c	U.S. EPA, 1984/ Ciba-Geigy, 1988, U.S. EPA, 1984
Arobenzene	NA; 2-year dietary	NA	rat	NA	abdominal cavity	B2/9.1E-9 (1.1E-1) ^{a,b}	B2/9.1E-9 (1.1E-1) ^a	U.S. EPA, 1990/ NCI, 1979; U.S. EPA 1988, 1990
Benzene	occupational; occupational	human	human	leukemia	leukemia	A/0.3E-8 (2.0E-2) ^a	A/0.3E-7 (2.0E-2) ^{a,b}	Ott et al., 1978; Rinsky et al., 1981 Wong et al., 1983; U.S. EPA, 1983, 1987, 1988, 1990/ Ott et al., 1978; Rinsky et al., 1981 Wong et al., 1983; U.S. EPA, 1983, 1987, 1988, 1990



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

APR 22 1991

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

OSWER DIRECTIVE 9355.0-30

MEMORANDUM

SUBJECT: Role of the Baseline Risk Assessment in Superfund
Remedy Selection Decisions

FROM: Don R. Clay *[Signature]*
Assistant Administrator

TO: Directors, Waste Management Division
Regions I, IV, V, VII, VIII
Director, Emergency and Remedial Response Division
Region II
Directors, Hazardous Waste Management Division
Regions III, VI, IX
Director, Hazardous Waste Division,
Region X

Purpose

The purpose of this memorandum is to clarify the role of the baseline risk assessment in developing Superfund remedial alternatives and supporting risk management decisions.

Specifically, the following points are made in the memorandum:

- o Where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 10^{-4} , and the non-carcinogenic hazard quotient is less than 1, action generally is not warranted unless there are adverse environmental impacts. However, if MCLs or non-zero MCLGs are exceeded, action generally is warranted.
- o Other chemical-specific ARARs may also be used to determine whether a site warrants remediation.
- o A risk manager may also decide that a baseline risk level less than 10^{-4} is unacceptable due to site specific reasons and that remedial action is warranted.

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- o Compliance with a chemical-specific ARAR generally will be considered protective even if it is outside the risk range (unless there are extenuating circumstances such as exposure to multiple contaminants or pathways of exposure).
- o The upper boundary of the risk range is not a discrete line at 1×10^{-6} , although EPA generally uses 1×10^{-6} in making risk management decisions. A specific risk estimate around 10^{-6} may be considered acceptable if justified based on site-specific conditions.
- o The ROD should clearly justify the use of any non-standard exposure factors and the need for remedial action if baseline risks are within the generally acceptable risk range. The ROD should also include a table listing the final remediation goals and the corresponding risk level for each chemical of concern.

Background

The 1990 National Contingency Plan (NCP) (55 Fed. Reg. 8665-8865 (Mar. 8, 1990)) calls for a site-specific baseline risk assessment to be conducted, as appropriate, as part of the remedial investigation (Section 300.430(d)(1)). Specifically, the NCP states that the baseline risk assessment should "characterize the current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water, releasing to air, leaching through soil, remaining in the soil, and bioaccumulating in the food chain" (Section 300.430(d)(4)). The primary purpose of the baseline risk assessment is to provide risk managers with an understanding of the actual and potential risks to human health and the environment posed by the site and any uncertainties associated with the assessment. This information may be useful in determining whether a current or potential threat to human health or the environment exists that warrants remedial action.

The "Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A" (HHEM) (EPA/540/1-89/002) provides guidance on how to conduct the human health portion of the baseline risk assessment. Volume II of the "Risk Assessment Guidance for Superfund" the "Environmental Evaluation Manual" (EPA/540/1-89/001) and the companion manual, "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference" (EPA/600/3-89/013) provide guidance on conducting the environmental portion of the baseline risk assessment. Other pertinent guidance includes the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (RI/FS guidance, EPA/540/G-89/004), which describes how the baseline risk assessment fits into the overall RI/FS process. "Guidance on Preparing Superfund Decision Documents" (ROD guidance)

(EPA/624/1-87/001) provides information on how to document the results of the baseline risk assessment in the ROD.

Objective

The objective of this memorandum is to provide further guidance on how to use the baseline risk assessment to make risk management decisions such as determining whether remedial action under CERCLA Sections 104 or 106 is necessary. This memorandum also clarifies the use of the baseline risk assessment in selecting appropriate remedies under CERCLA Section 121, promotes consistency in preparing site-specific risk assessments, and helps ensure that appropriate documentation from the baseline risk assessment is included in Superfund remedy selection documents.

Implementation

RISKS WARRANTING REMEDIAL ACTION

Whenever there is a release or substantial threat of release of a hazardous substance into the environment (or a release or threat of release into the environment of a pollutant or contaminant "which may present an imminent and substantial danger to public health or welfare"), Section 104(a)(1) of CERCLA provides EPA with the authority to take any response action consistent with the National Contingency Plan it deems necessary to protect public health or welfare or the environment. Section 106 of CERCLA grants EPA the authority to require potentially responsible parties (or others) to perform removal or remedial actions "when the President determines that there may be an imminent and substantial endangerment to the public health or welfare or the environment because of an actual or threatened release of a hazardous substance from a facility."

As a general policy and in order to operate a unified Superfund program, EPA generally uses the results of the baseline risk assessment to establish the basis for taking a remedial action using either Section 104 or 106 authority. EPA may use the results of the baseline risk assessments to determine whether a release or threatened release poses an unacceptable risk to human health or the environment that warrants remedial action and to determine if a site presents an imminent and substantial endangerment. The risk assessment methodology for all sites should be the same regardless of whether the RI/FS or remedial design and remedial action is performed by EPA or potentially responsible parties.

Generally, where the baseline risk assessment indicates that a cumulative site risk to an individual using reasonable maximum exposure assumptions for either current or future land use exceeds the 10^{-4} lifetime excess cancer risk end of the risk

range, action under CERCLA is generally warranted at the site. For sites where the cumulative site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 10^{-4} , action generally is not warranted, but may be warranted if a chemical specific standard that defines acceptable risk is violated or unless there are noncarcinogenic effects or an adverse environmental impact that warrants action. A risk manager may also decide that a lower level of risk to human health is unacceptable and that remedial action is warranted where, for example, there are uncertainties in the risk assessment results. Records of Decision for remedial actions taken at sites posing risks within the 10^{-4} to 10^{-6} risk range must explain why remedial action is warranted.

The cumulative site baseline risk should include all media that the reasonable maximum exposure scenario indicates are appropriate to combine and should not assume that institutional controls or fences will account for risk reduction. For noncarcinogenic effects of toxicants, unacceptable risk occurs when exposures exceed levels which represent concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime or part of a lifetime, as appropriate to address teratogenic and developmental effects.

Chemical specific standards that define acceptable risk levels (e.g., non-zero MCLGs, MCLs) also may be used to determine whether an exposure is associated with an unacceptable risk to human health or the environment and whether remedial action under Section 104 or 106 is warranted. For ground water actions, MCLs and non-zero MCLGs will generally be used to gauge whether remedial action is warranted.

EPA uses the general 10^{-4} to 10^{-6} risk range as a "target range" within which the Agency strives to manage risks as part of a Superfund cleanup. Once a decision has been made to take an action, the Agency has expressed a preference for cleanups achieving the more protective end of the range (i.e., 10^{-6}), although waste management strategies achieving reductions in site risks anywhere within the risk range may be deemed acceptable by the EPA risk manager. Furthermore, the upper boundary of the risk range is not a discrete line at 1×10^{-4} , although EPA generally uses 1×10^{-4} in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks. Therefore, in certain cases EPA may consider risk estimates slightly greater than 1×10^{-4} to be protective.

When an ARAR for a specific chemical (or in some cases a group of chemicals) defines an acceptable level of exposure,

compliance with the ARAR will generally be considered protective even if it is outside the risk range (unless there are extenuating circumstances such as exposure to multiple contaminants or pathways of exposure). Conversely, in certain situations EPA may determine that risks less than 1×10^{-6} are not sufficiently protective and warrant remedial action.

Where current conditions have not resulted in a release posing risks that warrant action but there is a significant possibility that a release will occur that is likely to result in an unacceptable risk, remedial action may also be taken. The significance of the potential future release may be evaluated in part based on the quantities of material at the site and the environmental setting.

RISKS CONSIDERED IN RISK MANAGEMENT DECISION

As noted above, both current and reasonably likely future risks need to be considered in order to demonstrate that a site does not present an unacceptable risk to human health and the environment. An adequate consideration of future risk may necessitate the assessment of risks assuming a land use different from that which currently exists at the site. The potential land use associated with the highest level of exposure and risk that can reasonably be expected to occur should be addressed in the baseline risk assessment. Further, this land use and these exposure assumptions should be used in developing remediation goals.

The preamble to the NCP states that EPA will consider future land use as residential in many cases. In general, residential areas should be assumed to remain residential; and undeveloped areas can be assumed to be residential in the future unless sites are in areas where residential land use is unreasonable. Often the exposure scenarios based on potential future residential land use provide the greatest risk estimates (e.g., reasonable maximum exposure scenario) and are important considerations in deciding whether to take action (55 Fed. Reg. at 8710).

However, the NCP also states that "the assumption of future residential land use may not be justifiable if the probability that the site will support residential use in the future is small." Sites that are surrounded by operating industrial facilities can be assumed to remain as industrial areas unless there is an indication that this is not appropriate. Other land uses, such as recreational or agricultural, may be used, if appropriate. When exposures based on reasonable future land use are used to estimate risk, the NCP preamble states that the ROD "should include a qualitative assessment of the likelihood that the assumed future land use will occur" (55 Fed. Reg. at 8710).

Unacceptable environmental risks also may prompt remedial action and may occur where there is no significant risk to human health. Threats or potential threats to sensitive habitats, such as wetlands, and critical habitats of species protected under the Endangered Species Act are especially important to consider when determining whether to take an action under CERCLA Section 104 or 106. Ambient Water Quality Criteria for aquatic organisms are chemical-specific standards that will generally be considered when determining whether to take an action based on the environmental risk of releases to surface waters.

NO-ACTION DECISIONS

If the baseline risk assessment and the comparison of exposure concentrations to chemical-specific standards indicates that there is no unacceptable risk to human health or the environment and that no remedial action is warranted, then the CERCLA Section 121 cleanup standards for selection of a Superfund remedy, including the requirement to meet applicable or relevant and appropriate requirements (ARARs), are not triggered. CERCLA section 121 (a) requires only that those remedial actions that are "determined to be necessary ... under section 104 or ... 106 ... be selected in accordance with section 121." If EPA determines that an action is necessary, the remedial action must attain ARARs, unless a waiver is invoked. Of course, sites that do not warrant action under CERCLA sections 104 or 106 may warrant action under another State or Federal statute, such as RCRA subtitle D requirements for the appropriate closure of a solid waste landfill.

The decision not to take action at an NPL site under section 104 and 106 should also be documented in a ROD. The decision documentation process should include the preparation of a proposed plan for public comment, ROD and eventually a closeout report and Federal Register deletion notice.

POINT OF DEPARTURE WHEN ACTION WARRANTED

Once remedial action has been determined to be warranted, the results of the baseline risk assessment may be used to modify preliminary remediation goals. These preliminary goals are developed at scoping based on ARARs and the 10⁻⁶ cancer risk point of departure pursuant to NCP section 300.430(e)(2)(i).

USE OF BASELINE RISK ASSESSMENT TO MODIFY PRELIMINARY REMEDIATION GOALS

Remediation goals developed under CERCLA Section 121 are generally medium-specific chemical concentrations that will pose no unacceptable threat to human health and the environment. Preliminary remediation goals are developed early in the RI/FS process based on ARARs and other readily available information.

such as concentrations associated with 10^{-6} cancer risk or a hazard quotient equal to one for noncarcinogens calculated from EPA toxicity information. These preliminary goals may be modified based on results of the baseline risk assessment, which clarifies exposure pathways and may identify situations where cumulative risk of multiple contaminants or multiple exposure pathways at the site indicate the need for more or less stringent cleanup levels than those initially developed as preliminary remediation goals. In addition to being modified based on the baseline risk assessment, preliminary remediation goals and the corresponding cleanup levels may also be modified based on the given waste management strategy selected at the time of remedy selection that is based on the balancing of the nine criteria used for remedy selection (55 Fed.Reg. at 8717 and 8718).

EARLY AND INTERIM ACTIONS

Early operable unit actions (e.g., hot spot removal and treatment) and interim actions (e.g., temporary storage or ground water plume containment) may be taken to respond to an immediate site threat or to take advantage of an opportunity to significantly reduce risk quickly (55 Fed. Reg. at 8705). For example, an interim containment action may be particularly useful early in the process for complicated ground water remedial actions, where concentrations greater than MCLs provide a good indication that remediation of a potential drinking water source is necessary; such quick remedial action is important to prevent further spread of the contaminant plume while a final ground water remedy is being developed.

Early and interim action RODs do not require a completed baseline risk assessment, although enough information must be available to demonstrate the potential for risk and the need to take action. Data sufficient to support the interim action decision can be extracted from the ongoing RI/FS for the site and set out in a focused feasibility study or other appropriate document that includes a short analysis of a limited number of alternatives (55 Fed. Reg. at 8704). These data should include a summary of contaminants of concern, concentrations and relevant exposure information. A discussion should accompany these data explaining the need for immediate remedial action based on the presence of contamination that, if left unaddressed in the short-term, either contributes immediate risk or is likely to contribute to increased site risk or degradation of the environment/natural resources. The early and interim action RODs should note that some exposure pathways at the site may not be addressed by the action.

An interim action ROD eventually must be followed by a subsequent ROD for that operable unit based on the complete RI/FS, that includes the baseline risk assessment, in order to document long-term protection of human health and the environment.

at that portion of the site. The interim action ROD, however, should demonstrate qualitatively (and quantitatively if possible) that there is a risk or potential for risk and explain how the temporary measures selected will address a portion of this risk.

DOCUMENTATION OF BASELINE RISK ASSESSMENT RESULTS IN THE ROD

The Summary of Site Risks section of the ROD should include a discussion of the risks associated with current and future land use and a table presenting these risk levels for each exposure medium (e.g., direct contact with soil by potential future residents exposed via incidental soil ingestion and dermal contact). In some situations, risks from exposure via more than one medium (e.g., soil and drinking water) will affect the same potentially exposed individual at the same time. It is appropriate in these situations to combine the risks from the different media to give an indication of total risk that an individual may be exposed to from a site.

In addition to summarizing the baseline risk assessment information, the ROD (except no-action RODs) should include how remedial alternatives will reduce risks by achieving cleanup levels through treatment or by eliminating exposures through engineering controls for each contaminant of concern in each appropriate medium.

The Comparative Analysis should include a discussion of each of the nine criteria; consideration of risk is part of the discussion of several of the criteria. The discussion of overall protection of human health and the environment should include a discussion of how the remedy will eliminate, reduce, or control risks identified in the baseline risk assessment posed through each pathway and whether exposure levels will be reduced to acceptable levels. For example, if direct human contact with contaminated soil is identified as a significant risk at a site, the ROD (except no-action RODs) should indicate how the selected remedy will eliminate or control exposures to ensure protection of human health. The discussion of long-term effectiveness and permanence should include, where appropriate, an assessment of the residual risk from untreated residual waste remaining at the site. The short-term effectiveness discussion should address risks during remedial action to those on-site and nearby.

Finally, that part of the Decision Summary in the ROD that focuses on the selected remedy should show:

- o the chemical-specific remediation level and corresponding chemical-specific risk level(s) to be attained at the conclusion of the response action and the points (or area) of compliance for the media being addressed; and

- o The lead agency's basis for the remediation levels (e.g., risk calculation, ARARs).

The attached table, "Remediation Levels and Corresponding Risks," provides a direct means of displaying this information for health risks and, where appropriate, environmental protection (Table 1). The table should be completed for all media for which the ROD selects final cleanup levels. The table should serve as a summary of text in the selected remedy section of the ROD Decision Summary. For interim action RODs, only qualitative statements may be possible.

Additional guidance on the baseline risk assessment and its role in remedy selection is available from several sources. For guidance on the baseline risk assessment contact:

David Bennett, Chief
Toxics Integration Branch (OS-230)
Hazardous Site Evaluation Division
Office of Emergency and Remedial Response
phone: (FTS) or (202) 475-9486.

For additional guidance on the interaction of the baseline risk assessment and Superfund remedy selection, contact:

David Cooper
Remedial Operations and Guidance Branch (OS-220W)
Hazardous Site Control Division
Office of Emergency and Remedial Response
phone: (FTS) 398-8361
(commercial phone: (703) 308-8361)

For guidance on enforcement-lead sites contact:

Stephen Ells
Guidance and Evaluation Branch (OS-510)
CERCLA Enforcement Division
Office of Waste Programs Enforcement
phone: (FTS) or (202) 475-9803.

NOTICE: The policies set out in this memorandum are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this memorandum, or to act at variance with the guidance, based on an analysis of specific site circumstances. Remedy selection decisions are made and justified on a case-specific basis. The Agency also reserves the right to change this guidance at any time without public notice.

TABLE 1

REMEDIATION GOALS AND CORRESPONDING RISKS^a

Final Remediation Levels ^b					Corresponding Risk Levels ^c	
Medium	Chemical	Remediation Level ^e	Point of Compliance ^f	Basis of Goal	Chemical-Specific RME Risk ^d	
					Cancer	Non-Cancer
SOIL	A	2.0 ppm	All facility grounds	HJ Risk GW Risk	N/A	0.5
	B	17.0 ppm			1.0×10^{-5}	N/A
	C	5.0 ppm			N/A	N/A
GROUNDWATER	B	0.1 ppm	Waste Management Unit Boundary	Risk MCL MCLG MCL	1.0×10^{-5}	N/A
	C	4.0 ppm			1.0×10^{-5}	N/A
	F	7.0 ppm			N/A	0.2
	G	15.0 ppm			6.0×10^{-6}	0.09
SEDIMENT	Q	100.0 ppm	Downstream from point A	Ecological Effects	N/A	N/A

^a Prepare summary sheets for selected remedy.

^b Final Remediation Levels are based on preliminary remediation goals developed in the Feasibility Study (FS) (RI/FS Guidance 4.2.1) as modified through the nine criteria evaluation and engineering design. In the process of achieving remediation levels for each chemical, some chemicals will be reduced to concentrations below their remediation levels.

^c Chemical specific risks correspond to associated remediation levels. Risks do not consider effects of exposures to other chemicals or media. If appropriate, risks may be summed to calculate media-specific risks. Short-term effectiveness is not considered.

^d Cancer risks are measured as individual incremental lifetime; non-cancer as Hazard Quotients.

^e Bases for values should be explained in the earlier Record of Decision (ROD) table.

^f Bases for location and method for determining attainment (e.g., maximum value detected over area XYZ) should be explained in the description of the selected remedy.

N/A - Not applicable

Woodward-Clyde

APPENDIX D
DATA COLLECTION PLAN

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INTRODUCTION

The Data Collection Quality Assurance Plan and Data Management Plan are attached and incorporated by reference. The plans are from the North Pond RFI Work Plan and are to be used as guidance where parameters and techniques are applicable.

The Vicksburg Chemical Corporation manufacturing facility (VCC) is located in Vicksburg, Mississippi. The facility is a manufacturer of chemicals. An U.S. Environmental Protection Agency (EPA) Determination of Release was issued for the facility in December, 1989. Negotiations for a Consent Decree began in January, 1990.

VCC has retained Woodward-Clyde Consultants (WCC) to perform an investigation that is technically consistent with a RCRA Facility Investigation (RFI) at the North Pond of the Vicksburg facility. WCC will conduct the investigation in compliance with the guidelines of the Consent Decree. Among the requirements and/or guidelines included in the decree are procedures to control the quality of data acquired during the investigation. This document presents the overall approach that WCC will undertake to verify that the information, data, and procured results meet the quality objectives. A detailed discussion of sampling procedures and methodologies for specific media is also given. For information on the description and background of the RFI for the entire facility, refer to the Preliminary Report.

DATA COLLECTION OBJECTIVES

2.1 DATA OBJECTIVES

The primary objectives of the North Pond RFI are as follows:

- Identify or verify the contaminants of concern for the North Pond area.
- Determine whether or not the North Pond area is releasing hazardous constituents into the environment.
- Identify the source of contamination
- Determine vertical and horizontal extent of contamination.
- Collect data to be used in determining the necessity and feasibility of corrective action measures.

To meet the overall objectives of the investigation, WCC will collect subsurface soil and groundwater samples. The following sections present the data requirements and strategy for collection of samples from each media.

2.2 QUALITY ASSURANCE OBJECTIVES

The objectives of the Quality Assurance/Quality Control (QA/QC) procedures are to produce data that meet (or exceed) the requirements of standard analytical methods and satisfies the project requirements. The objectives of the QA efforts for this project are as follows:

- To provide the mechanism for ongoing control and evaluation of the quality of data measurement throughout the project.
- Utilizing quality control data to define data quality for various measurement parameters in terms of precision and accuracy.
- To verify that all chemical samples are accurately and precisely collected, analyzed and documented so that proper treatment and/or disposal of waste material can occur.

- To verify compliance with the Department of Transportation and other agency requirements.
- To verify that samples are properly collected, analyzed and documented to provide data as part of the H&S Plan.

2.2.1 Definitions of Quality Assurance Terms

Definitions of precision, accuracy, completeness, representativeness, and comparability are presented in Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-0050/80, Office of Monitoring Systems and Quality Assurance and Office of research and Development, U.S. Environmental Protection Agency, Washington, D.C. 20460, December 29, 1980).

2.2.1.1 Precision

Precision is "a measure of mutual agreement among individual measurements of the same property. It is a measure of variability of individual sample measurements. Precision will be assessed from the laboratory duplicate analyses of field samples and from the set of duplicate matrix spiked samples. Precision will be measured as the percent difference in the duplicate measurements.

Average precision and its standard deviation of the concentration data for individual parameters will be used to evaluate the data collected and its acceptability for the objectives of the sampling. Data to be used in evaluation will meet the criteria defined herein and in Section 4.73 of this QAP. Confidence intervals will be derived for data sets using standard statistical methods. The precision criteria for laboratory QC samples is presented in Table 5.

2.2.1.2 Accuracy

Accuracy is "the degree of agreement of a measurement with an accepted reference or true value" and is a measure of a system bias. Bias is the difference between the mean of the true sample values and the mean of the laboratory analysis. Accuracy will be assessed using laboratory spiked standard matrix samples in conjunction with field and trip blank samples

and laboratory method and reagent blanks. Average accuracy and its standard deviation of the concentration data will be used if sufficient data are collected for a specific sampling activity. The accuracy criteria for the laboratory QC samples is presented in Table 5. Accuracy criteria for samples tested in accordance with SW 846, 3rd Edition procedures or equivalent will be in accordance with the appropriate analytical method.

2.2.1.3 Completeness

Completeness is "a measure of the amount of the valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions." The completeness of data objectives reflect the degree to which required samples specified in the appropriate sampling plan have been collected and the necessary analysis performed, in order to create a sufficient data base to meet the objectives.

The completeness objective for laboratory samples is presented in Table 5. If the completeness objective is not met, an evaluation will be undertaken to determine if resampling is required to provide adequate data to meet specific task objectives.

2.2.1.4 Representativeness

Representativeness "expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition." Representativeness is a function of the sample site selection and sample collection and analysis techniques. The objective of this program is to obtain samples which are representative of the media to be measured. The rationale of the selection of sample sites is provided in the project plans (including this QAP).

2.2.1.5 Comparability

Comparability "expresses the confidence with which one set of data can be compared with another." Comparability can be related to precision and accuracy since these quantities are measures of data reliability. Qualitatively, data subjected to strict QA/QC procedures will be deemed more reliable than data obtained from another project or previous study. To maintain comparability, the sampling method used, chain-of-custody procedures, EPA

analytical methods and qualified laboratories and establishment of strict QA procedures and sampling guidelines provide the basis for uniformity in all data collection and analysis activities.

2.2.2 Accuracy, Precision, and Sensitivity of Laboratory Analysis

The QA objective with respect to accuracy, precision, and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols.

The TCL and TAL parameters to be analyzed in the first round of samples are listed in Tables 2 and 3. The detection limits for metals analyses in accordance with SW846, 3rd Edition are presented on Table 4.

Accuracy and precision criteria for the parameters to be tested in accordance with EPA CLP protocols and SW846 is shown in Table 5. The accuracy and precision of laboratory analyses for samples tested in accordance with CLP and SW846 protocols will be determined by testing of laboratory blanks, duplicates, and spiked samples in accordance with the frequencies shown in Table 1. Compounds that are often used as matrix and surrogate spikes for CLP and SW846 organic analyses, and their control limits from CLP Protocols, are included in Tables 6 and 7.

2.2.3 Quality of Field Samples

Field duplicates, rinsate blanks, trip blanks, and matrix spikes/matrix spike duplicates will be taken in the field and submitted to the analytical laboratory to provide a means to assess the quality of the data resulting from field investigation tasks. Field duplicate samples will be analyzed to check for sampling and analytical reproducibility. Field and trip blank samples will be analyzed to check for procedural contamination and cross-contamination during shipment and storage of samples. Matrix spike/matrix spike duplicate samples will be analyzed to verify that recoveries falling outside acceptance windows are attributable to sample matrix interferences and not to laboratory analytical errors.

Field duplicates will be obtained at the frequencies indicated in Table 9. The samples will consist of obtaining a duplicate sample set for analysis from the sample. Rinsate samples

will be prepared by rinsing decontaminated equipment with deionized water and collecting the rinsate sample. Matrix spike and matrix spike duplicates will be collected in the field but they will be spiked in the laboratory. Trip blanks will be prepared by the laboratory and shipped with the sample containers. The trip blanks will be kept with collected samples and shipped back to the laboratory for analysis.

2.2.4 Accuracy of Field Measurements

Measurement data will be generated in many field activities that are incidental to collecting samples for analytical testing or unrelated to sampling. These activities include, but are not limited to, the following:

- Documenting time and weather conditions
- Determining depths in a borehole or piezometer and static water levels
- Measuring pH and conductivity of ground water samples
- Screening samples with an organic vapor analyzer (OVA) or photoionization detector (PID)

The general QA objective for such measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the intended use of such data through the documented use of standard procedures.

The QC level of effort for the field measurement of pH consists of pre-measurement calibration and post-measurement verification using two standard reference solutions each time to sample pH. This procedure will be performed for each sample tested. The QC effort for field conductivity measurements will include daily calibration of the instrument using standard solutions of known conductivity.

The accuracy of field measurements of pH will be assessed through pre-measurement calibrations and pH-measurements verifications using at least two standard buffer solutions. The two measurements must each be within ± 0.1 standard unit of buffer solution values. If measurements not within ± 0.1 , the problem will be evaluated. A fresh portion of buffer solution will be utilized. If the problem persists, a different (new) buffer solution will be used. Precision will be assessed through replicate measurements. (The electrode will be

withdrawn, rinsed and de-ionized water and re-immersed between each replicate). The instrument used will be capable of providing measurements to 0.1 standard unit. A total of four replicates for pH and conductivity will be performed.

The accuracy of measuring depths (for boreholes and static water levels) will be assessed by using a measuring device (weighted tape or electronic water level indicator such as an M-scope) that has been calibrated before use by measuring two known lengths. Any measurements taken with the device will be adjusted by the difference (if any) in length over the appropriate depth interval. At least three replicate depth measurements will be made and the average depth measurement will be used.

The data from the OVA or PID is used for screening only to select samples for analysis. After receiving laboratory data the OVA or PID and lab data will be evaluated for comparability.

SAMPLING OBJECTIVES

The specific objectives of the collection of the data are further discussed in the subsequent paragraphs.

3.1 GROUNDWATER SAMPLING DATA OBJECTIVES

As stated in the Preliminary Report water-bearing zones have been identified in previous investigations. Additional groundwater data may be needed to characterize these zones if contamination is found. Groundwater data needed could include:

- Approximate vertical boundaries of zones and stratigraphic relationships.
- Basic flow characteristics of each zone (direction, lateral flow rate, hydraulic conductivity, transmissivity and storage capacity).
- Hydraulic inter-relationships of the zones (vertical interconnection transmissivity between zones, etc).
- Effect of stratigraphic variations within each zone on contaminant transport.
- Nature and extent of contamination in each zone (approximate boundaries of contaminant accumulation).

Identification of water-bearing zone boundaries and relevant soil strata will require a detailed description of soil features (such as color, lithology, bedding, identifying features and relative degree of water saturation) to a depth sufficient to identify the base of the deepest contaminated water-bearing zone. The description will require accuracy to the nearest foot and professional geologic judgment to recognize and describe pertinent features.

The zones to be monitored will require sufficient screening intervals to characterize each zone. For low density immiscible contaminants (floaters), the screen will extend approximately two feet above the top of the zone to provide for fluctuations in water levels. If dense non aqueous phase contaminants are the concern (sinks) the screen will cover the base of the upper pervious zones and extend slightly below the base of the zone (± 6 inches).

If dissolved constituents are the concern, the screened interval will correspond to that portion of the zone which is judged to have the highest hydraulic conductivity. If required, deeper zones will be monitored utilizing similar approaches as describe above.

Determination of groundwater flow direction will require measurement of elevations of the top of the piezometric surface of each zone. A sufficient number and spacing of measurement stations will be installed to construct idealized contours of the piezometric surface elevations. The locations of measuring stations will be established such that they can be plotted on a site location map. Locations should be to the nearest 0.1 foot. Water level measurements should be made to the nearest 0.01 foot accuracy and reported in feet mean sea level (MSL). This data will be evaluated to verify the designated upgradient shallow well location and to identify upgradient background wells. As additional samplings are performed, the data will be reevaluated to verify results of previous sampling.

Determination of the nature and extent of groundwater contamination will require sampling and chemical analysis of groundwater from each water-bearing zone. A sufficient number of samples will be required to identify approximate lateral limits of contamination and establish and nature and concentrations of contaminants. Investigation of zones below the upper pervious zone will be performed if data does not define the vertical extent of groundwater contamination.

The samples will require analysis for Target Compound List (TCL) and Target Analyte List (TAL) constituents plus dinoseb as presented in the Contract Laboratory Program CLP Statement of Work to identify or verify contaminants of concern. Sample collection and handling will require strict adherence to EPA approved procedures and close QA/QC surveillance. Sample analysis will be performed by CLP methods.

3.2 AQUIFER TESTING OBJECTIVES

Determination of lateral and vertical flow rates, hydraulic conductivities, transmissivities, storage capacities and vertical interconnection will require in situ flow testing data. Lateral hydraulic conductivity/transmissivity data should be collected by at least two different methods in order to evaluate the credibility of the data and subsequent calculations. Storage capacity calculations and vertical interconnection determinations should be based on field

pumping test data. Aquifer testing will be done in conjunction with detailed design of corrective action, if required.

3.3 SURFACE SOIL SAMPLING DATA OBJECTIVES

The primary purpose of collecting surface soil data is to aid in determining potential for contamination of site runoff-water, potential for off-site migration of contaminated sediments (water transported) and/or potential for human/animal contact and/or ingestion. Consequently, sampling need not extend beyond about 12 inches below the natural ground surface. Background samples at 0 to 12 inches to 12 to 36 inches will be obtained in the site vicinity. The background sample locations are selected based upon the lack of hazardous waste activities in those areas. The surface soil data must include laboratory analysis for soil classification and contaminant content. Soil classification data is needed to estimate the erosion susceptibility and transportability of the soil. Atterberg limits for cohesive soil and sieve analysis data for noncohesive soils will be adequate for erosion susceptibility and transportability purposes. Laboratory analysis for contaminant content shall consist of TCL and TAL analyses using CLP methods.

3.4 SUBSURFACE SOIL SAMPLING DATA OBJECTIVES

The primary purpose of collecting subsurface soil (vadose zone) and soil structure data is to aid in determining the potential for downward percolation of contaminants into the shallow groundwater. Consequently sampling must be of sufficient quantity to identify lateral limits of contamination and must extent to a sufficient depth of identify and quantify accumulation of contaminants above and within the first occurring water-bearing zone. The data shall consist of laboratory analyses of the contaminated soil. Laboratory analyses shall consist of analysis for TCL and TAL compounds in accordance with CLP protocol plus dinoseb .

3.5 SUBSURFACE SLUDGE SAMPLING DATA OBJECTIVES

The primary purpose of sludge sampling will be to determine toxicity characteristics for removal and treatment and/or disposal. Laboratory analysis shall consist of TCLP analysis.

3.6 SAMPLING ACTIVITIES

The sampling activities will occur during the North Pond RFI to address the data objectives for the media of concern identified above. A general location map of the North Pond area is presented as Figure 1 and sampling location maps are presented as Figures 2, 3, and 4. The field investigation tasks to obtain the data will generally consist of the following:

- Obtaining sampling location characteristic information from topographic and information surveys.
- Obtaining background and current groundwater quality data from the existing site monitor wells (already completed).
- Subsurface soil sampling to evaluate the vertical and horizontal extent of contamination and constituents if released.
- Groundwater assessment and sampling (piezometer installation, sampling and evaluation) to determine the areal and vertical extent of groundwater contamination and determine groundwater flow discretion.

SAMPLING EQUIPMENT, PROCEDURES, AND MEASUREMENTS

The sampling locations, depths, type (grab vs. composite), number of samples, and analytical parameters were discussed in the North Pond RFI Work Plan approach and scope of work. The procedures and equipment to perform the sampling for the North Pond RFI were discussed only in general terms in that document and are presented in more detail herein. In addition, procedures for piezometer or monitor well installation and aquifer testing are presented. The sampling procedures presented below will be implemented along the North Pond RFI Work Plan approach and scope of work as appropriate. Changes in the procedures discussed here in will be documented and included in the interim reports. Additional specifications with respect to documentation, equipment, and procedures as required by VCC standard policies and manuals which do not affect data quality objectives may be incorporated into the work plan as appropriate.

4.1 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling will be performed to characterize the wastes and to evaluate the extent of subsurface soil contamination, if any. A series of borings have been drilled to evaluate the stratigraphy and determine locations for discrete sampling as well as for piezometers. The equipment and methods are discussed below along with an alternative method.

4.1.1 Equipment

Subsurface sampling will be performed by rotary auger or hollow-stem drilling methods. The drilling apparatus will consist of a truck-mounted drilling rig. Samples will be obtained by drilling using a 3-inch diameter Shelby tube, or 2-inch diameter split spoon sampler.

Only petroleum jelly, teflon tape, lithium grease, or vegetable-based lubricants shall be used on the threads of downhole drilling equipment. Additives containing lead or copper shall not be used. Any hydraulic or other fluids used in the drilling rig, pumps, or other field equipment/vehicles shall not contain any polychlorinated biphenyls (PCBs).

If antifreeze is added to any pump, hose, etc., in an area in contact with drilling fluids, this antifreeze shall be completely purged prior to the equipment's use in drilling, mud mixing, or any other part of the overall drilling operation. Only antifreeze without rust inhibitors and/or sealants may be used.

Drilling equipment that has a visible loss of grease, hydraulic fluids, oils, fuels and/or transmission oil to drilling fluids to the borehole will not be allowed for borings and/or well installation until the problem is corrected.

Hydraulic rotary drilling operations will use portable recirculation tanks/pans for the "mud pit" and for mixing grout. Dug pits or sumps will not be used.

4.1.2 Procedure

The borings shall be continuously sampled with a thin-walled Shelby tube sampler or split-spoon sampler, extruded in the field and described or logged, following the guidelines of the appropriate and most current American Society for Testing and Materials (ASTM) Standards:

- D 1452 Practice for Soil Investigation and Sampling by Auger Borings,
- D 1586 Method for Penetration Test and Split-Barrel Sampling of Soils,
- D 1587 Practice for Thin-Walled Tube Sampling of Soils,
- D 2487 Test Method for Classification of Soils for Engineering Purposes, and
- D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure).

All borings shall be sampled and described by a qualified WCC representative. The qualified WCC representative is to be on-site during all boring and sampling operations. Samples taken from borings will be handled as described later in this section.

All soil borings will be advanced with rotary or hollow-stem drilling techniques with continuous soil sampling techniques unless it is determined to be unnecessary for strata identification and sample collection by the qualified WCC representative based on consistent site conditions. If the borehole becomes unstable and caving or sloughing of the walls

develop, temporary surface casing may be used in the drilling operations. Dry rotary auger or hollow-stem techniques will utilize an auger and cut and clear the borehole for sampling. Rotary wash will utilize potable water that is recirculated through the borehole to remove cuttings. Bentonite drilling mud (organic free) will be used only if required to maintain borehole stability.

The samples obtained from the borings will be screened in the field for head-space analysis using an on-site OVA or PID. Immediately upon removal of the soil sample from the Shelby tube or split spoon, the field geologist will visually log it. The visual logging will describe soil type and secondary color, penetration resistance and inclusions as described above. A portion of the sample will then be shaved with a clean knife or spatula to remove at a minimum the outer approximately one-fourth inch which may have come in contact with the downhole fluids. This shaved sample will then be divided into two parts, each of which will be labeled based on boring number and sample depth. One portion of the sample will be placed in a glass jar, labeled, and placed on ice. The other portion will be placed in a wide mouth glass jar covered with aluminum foil and capped. The headspace will be sampled by inserting the probe of the OVA into a predrilled hole in the cap through the aluminum foil. The OVA or PID reading will be made immediately and the reading recorded on the boring log.

Based on the OVA or PID readings or visible contamination and paragraph 3.1 of the RFI Field Investigation Work Plan for the North Pond, the qualified WCC representative will select samples for chemical analysis (as described above) to consist of TCL and, TAL constituents. The testing protocols to be followed are discussed in the Data Management Plan. Samples will be retained on ice or refrigerated until delivery to the laboratory. One sample in 20 will be split to provide field duplicate samples for analysis and one rinsate blank will be collected for analysis from each drilling rig decontamination during drilling.

Shallow rotary borings will be drilled to the water table and will be advanced by dry-auger methods until free water is encountered. For borings drilled for shallow piezometer installation, drilling operations will be stopped for ten minutes when water is encountered to allow the water level to rise. Both the initial and second water level will be measured and recorded. Borings drilled for shallow piezometer installation will be drilled to the base of the first water-bearing zone encountered.

Borings drilled prior to deep piezometer installation will be drilled to the base of the deep water-bearing zone. The borings will be drilled in a manner similar to that previously described. The boring will be advanced by dry auger methods to the water table. Drilling will be stopped for approximately 10 minutes to allow the water level to rise. Both the initial and second water level will be measured and recorded.

The borings will be continuously sampled and field screened with an OVA or PID (as described previously). The deep borings may be cased, at the discretion of the WCC Site Coordinator, to a depth to be determined in the field based upon the OVA or PID screening (to a nondetectable level) or the shallow water-bearing zone, whichever is deeper. Drilling will resume through the casing to the boring completion depth. Upon completion of drilling, the casing will be pulled and the borehole will be grouted as the casing is advanced out of the hole from the base of the borehole to ground surface. Grouting will be performed as described later in this section. The deep piezometer will be installed in the deep boring.

4.1.3 Documentation

Subsurface soil sampling will be documented in the filed log book as well as on a boring log form for each boring drilled. The boring log will be of a form equal to or similar to Figure 5. Pertinent information will, at a minimum, include boring number, date, logger, lithologic description, core recover, OVA or HNu readings, depth of water table and boring completion data.

The following information shall be routinely entered or attached to the soil boring log:

- Depths/heights shall be recorded in feet and fractions thereof (tenths).
- Soil classifications shall be in accordance with the Unified Soil Classification System (equivalent to ASTM D 2487 and 2488).
- Soil classifications which have been prepared in the field at the time of sampling by a WCC representative and are subject to change based upon laboratory tests and/or subsequent review. Factors to consider before changing a field determination include the expertise of the field geologist and laboratory personnel, representative character of the tested sample, labeling errors, etc.

Each soil sample taken shall be fully described in the log. The descriptions of intact samples shall include the following parameters:

- Lithologic Classification and Unified Soil Classification
- Color
- Plasticity
- Consistency (cohesive soil)
- Density (noncohesive soil)
- Moisture Content. Use relative term.

Other information to be placed on the soil boring logs, as appropriate, include:

- The drilling equipment used will be generally described either on each log or in a general legend.
- Each log will record the drilling sequence.
- All special problems and their resolution will be recorded on the log; e.g., hole caving, recurring problems at a particular depth, sudden tool drops, excessive grout takes, drilling fluid losses, unrecovered tools in hole, lost casing, etc.
- The dates for the start and completion of borings shall be recorded on the log.
- Each sequential boundary between the various soils and individual lithologies shall be noted on the log by depth. When depths are estimated, the estimated range shall be noted along the boundary.
- The depth of first encountered free water shall be indicated along with the method of determination. In addition, when free water is first encountered the following procedure will be followed; Allow the first encountered water to partially stabilize (10 to 15 minutes) and record this secondary level and time between measurements before proceeding.
- The estimated depth interval for each soil sample taken, classified, and/or retained shall be noted on the log. For each driven (split spoon), thin wall (shelby), and cored sample, the length of sample recovery and the sampler type and size (diameter and length) will be recorded.

- For thin wall samplers it should be indicated whether the sampler was pushed or driven. Blow counts shall be recorded in half foot increments when standard (1 3/8" ID by 2" OD) samplers are used. For penetration of less than a half foot, it will be noted in the log along with the blow count and the distance over which the count was taken.
- Special abbreviations used on a soil boring log and/or well diagram will be defined either in the log/diagram where used, or in a general legend.

4.2 SURFACE SOIL OR SLUDGE SAMPLING

Soil samples will be obtained from areas that are potential pathways for surficial contaminant migration. Sludge samples will be collected in areas as discussed in the Field Investigation Work Plan.

4.2.1 Equipment

Sampling equipment will consist of hand sampling tools such as trowels, shovels, a drive tube sampler or a hand auger. Stainless steel or PVC sampling tools will be used.

4.2.2 Procedure

The sample locations will be referenced to site coordinates. The sampling area will be first cleared of vegetation and/or debris. The sample will be collected to a depth of 12 inches such that minimal volatilization is allowed and then transferred in the appropriate container. The hole will be backfilled with native soils and vegetation.

4.2.3 Documentation

As previously stated, the sampling point will be referenced to the site coordinate system and, if taken with an areal grid, the node number will be recorded. Visual classification and other observations will also be noted in the field log book along with sample number, time, date, and other pertinent information.

4.3 GROUNDWATER SAMPLING

4.3.1 Water Level Measurement

4.3.1.1 Water Level Determination

The elevation at the top of the casing (TOC) should be established at each piezometer. This information will be used to determine the water level elevation. To calculate the water level elevation, the distance to the water level from the TOC needs to be measured. This can be achieved by either of the following procedures:

4.3.1.1.1 Weighted Tape Procedure. A weighted tape must be decontaminated prior to use and between wells by procedures detailed in Standard Operating Procedures (SOP) 3.5. The weight should consist of an inert, open-ended object that will create a distinct sound when tapped on the water's surface. The weight should be lowered gently into the well until it is heard to have touched the water. The water level measurement from top of casing to water level should be determined to the ± 0.01 foot and recorded in a logbook. A measurement of well depth from the top of the casing to the bottom of the well should also be made. This measurement can be used to determine if a significant silt build-up has occurred at the bottom of the well or that the well casing is not blocked. NOTE: When using a weighted tape, be sure that the weight is not secured using an adhesive tape (duct tape, strapping tape, etc.) as the adhesive may contain organic compounds which could contaminate the well.

4.3.1.1.2 Electronic Water Level Indicator Procedure. An electronic water level indicator must also be decontaminated prior to use and between wells. The indicator probe, connected to a graduated wire is lowered down the well casing. A light turning on or a meter deflection occurs when the electrical circuit is closed indicating that the probe tip has touched the water. The reading should be taken to the nearest 0.01 foot by recording the length of graduated wire between the TOC and the water level (probe tip) in a logbook. Additionally, a measurement of well depth should be made from TOC to the bottom of the well using the probe.

4.3.1.2 Cross-Contamination Minimization

In areas of known contamination, the sequence of water level measurement should be done, whenever possible, from the well least likely to be contaminated to the well most likely contaminated to reduce the potential for cross-contamination. If this information is not available, an attempt should be made to sample upgradient wells first and then downgradient wells.

4.3.1.3 Calculation of the Volume of Standing Water

The water level measurement is used to calculate the volume of standing water in the well from the linear feet of standing water and the well diameter. This calculation is then used to determine the volume of water to be purged from the well prior to sampling. To calculate the linear feet of water in the well, subtract the depth to the water from the total depth of the well. Form the table below determine the appropriate factor for the specific well inside diameter; multiply the linear feet by the appropriate factor listed on the table below to get the gallons of water present in the well.

Casing Diameter	Casing Volume
2 inches	0.163 gallons/foot
3 inches	0.367 gallons/foot
4 inches	0.653 gallons/foot

For example, if depth to water is 7.5 feet, and the total depth of the 2-inch diameter well is 20 feet, then 12.5 feet of standing water is in the well. Volumetrically, 0.163×12.5 (2-inch well), or 2.04 gallons of standing water are in the well.

4.3.1.4 Free-Phase Immiscible Contamination

If contamination of groundwater by free-phase immiscible chemicals is suspected, procedures for the detection of immiscible, or nonaqueous phase liquids (NAPL) should be employed. The presence of dense NAPL (heavier than water) or light NAPL (less dense than water) can be determined by the use of an electrical interface probe. The probe should be carefully and

slowly lowered into the well. A deflection of the needle on the scale of the probe will indicate the air/light NAPL interface, light NAPL/water interface, and water/dense NAPL interface, respectively. The thickness of immiscible contaminants is to be recorded in a logbook.

4.3.2 Piezometer Evacuation - Purging

In order to obtain a representative sample of groundwater, the standing water in the well casing should be purged or evacuated. Evacuation allows fresh or formation groundwater to enter the well. The optimum method to ensure that formation water is sampled, is to monitor the water being purged by field measurements of pH, temperature and conductivity. For each volume of standing water purged from the well (as calculated earlier) a measurement of these three indicator parameters should be taken. When the subsequent sample are observed to have less than ± 10 percent variation in these parameters, the well is presumed to be adequately flushed. At a minimum, three standing water volumes as should be removed; however, in wells with very low recoveries this goal may not be practical. When full recovery exceeds two hours, the well should be purged to dryness. If the well is evacuated to dryness, samples of the groundwater should be collected within 24 hours of evacuation.

Evacuation rates should be kept well below 10 gallons per minute and in most cases should be below 5 gallons per minute. At no time should a well be pumped to dryness if recharge rates cause groundwater to vigorously cascade down the sides of the screen which can potentially cause an accelerated loss of volatiles. If at all possible, the water should be drawn down from above the screen in the uppermost part of the water column in high yield formation to ensure that fresh water from the formation will move upward in the screen. In low yield formations, water should be purged so that it is removed from the bottom of the screen.

Evacuation of a well can be accomplished in several different ways. In any instance it is paramount to ensure that the evacuation procedure does not cause cross-contamination from one well to the next. Therefore, the preferred method employs dedicated equipment whenever possible. The selection of an evacuation method often relies on the depth of the water in the well, as discussed below. The following are potential evacuation methods:

4.3.2.1 Bailer Purging

Bailers can be used to evacuate shallow wells, and through there are no prohibitive factors preventing their use in deeper wells, the time required and physical strain on the individual purging the well makes hand bailing a less desirable evacuation method for deeper wells. Ideally, if a bailer is used, it is dedicated to one well and often remains hanging from the well cap in the well between use. Regardless of whether the bailer is dedicated or not, it should be decontaminated before use. Decontamination procedures should be followed.

The preferable materials of bailer construction are teflon, stainless steel, polypropylene, polyethylene, vitron, and polyvinyl chloride (PVC). The bailer should be lowered into the well using a nonporous rope made out of material such as polypropylene or teflon-coated cord. Caution should be used when lowering the bailer into the water so as to avoid aeration of the well water. Retrieve the bailer after it is filled and pour water into a graduated container to measure the amount of water removed from the well. Care should be taken to keep the rope and bailer from touching the ground or other potentially contaminated surfaces. When the first standing water volume has been removed, a groundwater sample should be collected from the bailer for field measurements of pH, temperature, and conductivity. These field measurements should be repeated for each subsequent standing water volume removed.

4.3.2.2 Mechanical Pump Purging

Suction lift pumps such as centrifugal, diaphragm, or peristaltic pumps can be used to evacuate wells if the static water level is within 25 feet of ground surface. These pumps are utilized at ground surface with the intake line connected to dedicated teflon or high-density polyethylene tubing inserted into the well. The tubing should be equipped with a foot valve to avoid having aerated water from the pump fall back in the well. The outlet tubing should be placed so that the purge water is collected in a graduated container, and can be measured. Deionized water should be used if priming is necessary. Measurements of pH, conductivity, and temperature should be taken for each standing water volume evacuated from the well. If the well is pumped dry and the recharge rate is sufficiently rapid to cause water to cascade into the well, the well should be allowed to recover. Then the pumping rate should be adjusted to a slower rate and the well re-evacuated of two standing water volumes before sampling.

4.3.2.3 Submersible Pump Purging

Portable submersible pumps are an option for evacuating wells with water levels greater than 25 feet below land surface. One such pump is an electrically powered (110 or 230 V AC) centrifugal pump with an isolated motor. Another is an air displacement pump in which a stainless steel reservoir with check valves at each end alternately fills from the bottom with water from the well, and evacuates when air or compressed gas (nitrogen) is discharged into the reservoir from the top. The decontaminated pump should be carefully lowered into the well, trailing a discharge hose, electrical cables or air lines, and a stainless steel security cable (which should bear most of the weight). If these items are to be bundled, use plastic ties and not electrical tape or duct tape.

If the pump is connected to a portable gasoline generator or air compressor, the generator should be placed some distance away from the well where fumes can not affect sample quality. An inline air filtration system at the discharge line should be used when an air compressor is used in conjunction with an air displacement pump. The submersible pump provides the advantage of high flow rates, however, care should be taken when operating to keep the flow rate within an acceptable limit for the particular well yield (recharge capacity). As with the suction lift pumps, these pumps should be equipped with a foot valve and fitted with dedicated tubing.

To evacuate, simply turn the pump on, prime with de-ionized water if needed, and measure the outlet water quantities. As with all other evacuation methods, pH, temperature, and conductivity should be measured for each standing water volume removed. These pumps need to be decontaminated prior to sampling and between sampling points.

4.3.2.4 Bladder Pump Purging

A bladder pump or gas squeeze pump consists of a housing that encloses a flexible membrane (bladder) that has check valves above and below. The pump is connected to either bottled gas or an air compressor. When in operation, water enters the membrane/bladder through the bottom check valve; compressed gas is injected into cavity between the housing and the bladder, squeezing the bladder and forcing the water through the top check valve and ultimately out of the well. Another type of bladder pump is also available that works on the same principle except that the water enters the chamber between the membrane and the casing, and the gas is injected into bladder. Similar to the submersible pumps, the bladder pump should be carefully lowered into the well by a security cable. In low-yielding wells (i.e., wells incapable of producing three well volumes), the bladder pump should be placed at the bottom of the well screen so that water is removed from the bottom of the well screen.

The outlet tubing from the bladder pump should be placed so that purge water can be collected into a graduated container. Field measurements of temperature, pH, and conductivity should be taken for each standing water volume evacuated from the well.

4.3.2.5 Inertia Pump Purging

An inertia pump consists of a PTFE footing which is essentially a reservoir with check valves at the bottom inlet and top outlet, and a tube rising to the wellhead. An up-and-down movement of the tube pumps water through inertia derived from the upward movement of water with each stroke. The whole system is dedicated and can be pumped by hand, by the use of a hand-operated lever, or by using an electrically powered (110 V AC) motor. An optional bellows attachment provides suction to the tubing and greatly increases the pumping capacity.

To evacuate, simply pump by hand, or connect the motor. If a portable generator is used, take care to place it some distance away from the well where fumes cannot affect sample quality. Field measurements of pH, temperature, and specific conductivity should be taken for each standing water volume removed.

4.3.3 Piezometer Sampling

After evacuation of an adequate volume of water from the piezometer sampling can begin. Sampling of the piezometer should occur as soon as possible after evacuation, preferably immediately and must occur within 24 hours of completion of purging activities. Of the methodologies used for monitor well evacuation it is recommended that samples be collected only by using either the bailer, inertia pump, or the bladder pump. Due to the manner in which the other pumps (suction lift and submersible pumps) operate and the potential effect on the quality of the samples, it is not advisable to collect samples for volatile organic analysis with them.

4.3.3.1 Sample Collection

Prior to collecting the groundwater samples, the appropriate sample containers and preservatives should be set out and readily available for sample collection. Ideally, the sample containers should be cleaned and prepared by the laboratory that is going to conduct the analysis. Some of the parameters for which samples are to be collected will require a preservative.

The monitor well cap of each well will be removed carefully to avoid the incorporation of any contaminants in the well. Any plants or small trees that will be close to the well will also be removed, if possible. Prior to sampling, the initial static water elevation will be measured and recorded. The water level will be measured from the top of the riser piper to the nearest 0.01 foot using a calibrated electronic probe water level sensor (M-scope) or weighted tape (with sounder). Three replicate measurements will be made to verify accuracy. The probe or tape will be cleaned with deionized water after each use.

Following water level measurements, the well will be purged to remove stagnant water which would otherwise bias a representative sample. The purging will be performed using a dedicated bailer. The well will be purged until water parameters of pH, specific conductance, and temperature have stabilized and at least three well volumes or the well is purged to dryness. Purged water will be containerized for treatment. Measurements of pH, specific conductance, and temperature will be taken and recorded during the purging.

Vehicles or any other equipment that might be a potential source of contamination will be placed at a distance far enough from the wells during purging or sampling.

After purging, the well will be sampled with a dedicated or clean bailer. Clean plastic sheeting will be placed on the ground around each well to prevent contamination of the ground or any sampling equipment which is dropped. Care will be taken so that the sample is taken from the screened interval of the well. Samples will be retained in appropriately preserved laboratory containers. No head space will be allowed in VOA vials.

Samples will be collected and containerized in the order of the parameters volatilization sensitivity. Samples for organic compounds should be collected initially. Care will be taken not to allow the bailer to come into contact with the container while pouring the samples.

The following are potential sampling methods:

4.3.3.1.1 Bailer Sample Collection. If a bailer is used for sample collecting, the same bailer used to purge the well may be used to sample it. An effort will be made to keep the rope from touching the ground or the casing. The bailer will be lowered slowly into the water. Do not let the bailer free fall into the water. Attempt to lower the bailer to the same depth in the well each time. Retrieve the bailer smoothly but quickly and empty the water into the sample container in a steady stream. Samples should be collected in the following order: Volatile Organics, Total Organic Carbon, Semivolatile Organics, and any other compounds. Once collected, the samples should be labeled using a waterproof label and waterproof ink, sealed in plastic bags, and placed on ice in an ice chest and cooled to 4°C. The sample number, amount collected, and time collected should be recorded on a chain-of-custody form and in a logbook.

4.3.3.1.2 Bladder or Inertia Pump Sample Collection. If a bladder pump or an inertia pump is used, the same tubing that was used to purge the well may be used to sample it. The samples should be collected in the following order: Volatile Organics, Total Organic Carbon, Semivolatile Organics, and any other compounds. When collecting samples for the analysis of volatile compounds, the pumping rate should not exceed 100 milliliters per minute. After these samples are collected the pumping rate can be increased for collection of other samples. Once collected, the samples should be labeled using a waterproof label and

waterproof ink, sealed in plastic bags, and placed on ice in an ice chest cooled to 4°C. The sample number, amount collected, and time collected should be recorded on a chain-of-custody form and in a logbook.

4.3.3.2 Cross-Contamination Minimization

As with purging, the sequence of monitor well sampling should be done, whenever possible, from the well least likely to be contaminated to the well most likely contaminated to reduce the potential for cross-contamination. If this information is not available, an attempt should be made to sample upgradient wells first and then downgradient wells.

4.3.3.3 Collection for Metal Analysis

If analysis for metals is required, water samples that contain high concentrations of sediment may be field filtered before the sample is collected for metal analysis. A hand pump and a filter device can be used, or an in-line filter (0.45 micron) in conjunction with the bladder or inertia pump. The groundwater sample should be run through the filter and collected in a clean sample container. It is recommended that a second sample should be sent to the laboratory for analysis. All equipment should be decontaminated before filtering and between sampling locations.

4.3.3.4 Use of Dedicated Equipment

If possible, the equipment used to sample a well should be dedicated equipment. If a bailer is used, each well should have a dedicated bailer that is stored in the well. Another alternative which is preferred over nondedicated sampling equipment is a disposable bailer which may be used for a single well sampling. If a bladder pump is used, each well should have dedicated tubing. Dedicated equipment should still be decontaminated prior to use. By using dedicated equipment, the chances of cross-contamination are greatly reduced.

4.3.3.5 Collection for Volatile Organic Analysis

Special care should be taken when collecting samples to be analyzed for volatile compounds. The water should be transferred slowly from the bailer, bladder, or inertia pump to the

sample container to reduce the potential for aeration of the samples. Samples requiring the analysis for organics should not be filtered or transferred from one container to another because losses of organic compounds onto the walls of the containers or aeration may occur. Samples to be analyzed for Total Organic Carbon (TOC) should be handled and analyzed as materials containing volatile organics. No headspace should exist in the sample containers for volatile compounds or TOC to minimize the possibility of volatilization of organics.

4.4 QUALITY CONTROL SAMPLES

To attain the project quality assurance objectives discussed in this document, certain Quality Control (QC) samples need to be collected and sent to the laboratory. The following is a discussion of those samples:

4.4.1 Trip Blanks

These samples consist of laboratory-prepared VOA vials, filled with volatile organic-free water which are shipped with the sample containers. These vials remain in the sample cooler and are not to be opened. They will be analyzed in the same manner as the collected samples, and are used to monitor volatile organic compounds due to container contributions or contamination during shipment. A trip blank shall accompany each sampling event (defined as the duration of the sampling of the wells in the plant) for which sample for volatile organic analysis are being collected.

4.4.2 Rinsate Blanks

These samples are used to monitor contamination resulting from the sampling equipment and also to monitor the effectiveness of equipment decontamination procedures. Rinsate samples are collected by pouring reagent grade water over decontaminated sampling equipment, in such a manner as to contact the same surfaces as the samples and collecting that water for analysis. Rinsate blanks will be collected at a minimum of one per sampling event. If there is more than one type of parameter being monitored in that sampling event, the rinsate blank will be analyzed for only the organic constituents (volatile and semivolatile, if applicable).

4.4.3 Sample Preservation and Shipment

The appropriate preservative will be added to each sample bottle by the laboratory prior to being taken into the field. Table 8 lists containers, preservatives, and holding times for the parameters being analyzed in this program.

Once the sample is placed in the bottle, a label should be affixed to the bottle. The label shall contain the following information: plant area, sample number (monitor well number), date, time of sample collection, parameter for analysis, preservative (if any), and the collector's name. The samples shall be placed in an ice chest containing an adequate volume of ice to maintain samples at 4°C. The ice chest should be sealed for shipment.

All samples will be continuously tracked in the field and while in transit. A chain-of-custody form shall accompany the samples at all times. The sample custody procedures are further described in Section 4.4 of this document.

4.5 GROUTING

Following completion of each borehole, the borehole will be grouted with a cement/bentonite grout (4 to 8 percent bentonite by dry weight). The grout shall consist of Portland cement and powdered sodium bentonite. The grout mix will consist of a pumpable cement/bentonite slurry. The grout shall be mixed in clean, above ground, rigid containers with an appropriate quantity of water. The mixing of each component will be achieved by a mechanical paddle

device or recirculation with a grout pump. Mixing activities will continue until a smooth, lump free consistency is achieved.

The grout mixture shall be pumped through a rigid, side discharge tremie pipe placed approximately 6 inches above the bentonite seal for monitor well installation or on the bottom of the hole for plugging and abandonment of soil borings. The grout mixture shall be pumped until undiluted grout flows from the annulus at the ground surface. The tremie pipe may be slowly withdrawn during grouting operations. The estimated volume of grout will be computed for each boring or well, based upon borehole dimensions and well dimensions. If actual grout placed is less than or exceeds 50 percent of the computed volume, the grouting for that boring or well will be evaluated to determine if grouting problems are present (i.e. caving or excessive grout takes).

After a minimum 24-hour period, the boring or well will be inspected for settlement of the grout and more grout will be added as needed. This process shall be repeated until firm grout is at or within one foot of the ground surface.

The specifications for the materials making up the grout are:

- Bentonite will be powdered, granular, or chipped sodium montmorillonite furnished in moisture resistant sacks and without additives.
- Cement will be a low-alkaline Portland Cement, Type I in conformance with ASTM C-150 and without additives.

4.6 AQUIFER TESTING (To be implemented prior to detailed design of corrective action)

Single well tests are referred to as slug tests. These tests are performed by suddenly adding or removing a slug (known volume) of water from a monitor well and observing the recovery of the water surface to its original level. In systems where the entire depth of the aquifer formation is screened, such tests provide information on the horizontal component of hydraulic conductivity. When only a portion of the aquifer depth is screened, the slug test results give a hydraulic conductivity containing both horizontal and vertical components. Most of the pressure loss (head loss) is dissipated in a horizontal direction, therefore, the

value of hydraulic conductivity evaluated is assumed to be most horizontal. Bower (1978) discusses a slug-test procedure applicable to fully or partially penetrating wells in unconfined aquifers. He discusses the use of dimensionless solutions of the Thiem equation to determine the hydraulic conductivity from observed values of water level and elapsed time.

4.6.1 Equipment

Slug testing equipment will consist of:

- Pressure transducer(s)
- Suspended weight of known volume (slug).
- Electric water level probe and/or steel tape.
- Data logger (recorder)
- Field data printer.

Since the pumping test program will be developed as needed after performing the slug testing, it is not possible to identify equipment to be used in conducting the pumping test(s) at this time. A listing of such equipment will be compiled when the pumping test program has been developed.

4.6.2 Procedure

The specific slug test performed will be a falling head test followed by a rising head test. Measurements of the behavior of the piezometer system as it returns to equilibrium are then made and used for analysis. The test will be run until the system has achieved 90 percent equalization. Field procedures for slug testing are as follows:

- The magnitude of instantaneous head change resulting from introduction or removal of the slug shall not cause water to overflow the casing. To assure meeting these requirements, magnitude of head change shall be determined prior to introduction of the slug. The magnitude determination shall be based on the calculated volume of the slug and the inside diameter of the casing. The test shall proceed only when these requirement are met.

- All equipment shall be decontaminated prior to placing into the piezometer. Decontamination shall consist of triple rinsing with deionized water.
- The static water level shall be measured using an electronic water level sensor or weighted tape.
- When the transducer is lowered into the piezometer and in place, the slug shall be introduced as rapidly as possible without causing undue splashing or turbulence so as to produce an instantaneous head increase. The instant the slug is set in place, the reference time will be time zero.
- Water levels shall be measured continuously (millisecond intervals) with the transducer and recorded with the data logger unit. Measurements shall be terminated when the water level stabilizes or when the water level has reached a level within 10 percent of static level.
- Water level measurements recorded shall be checked for credibility before proceeding to the next testing stage (removal of the slug).
- When checking of data has been completed and the previous testing has been determined to be acceptable, the slug shall be removed as rapidly as possible to produce an instantaneous head reduction. The instant the slug is removed from the water, the reference time will be time zero.
- Water levels shall be measured continuously (as in the previous testing stage) using the transducer and shall be recorded using the data logger unit. Measurements shall be terminated when the water level stabilizes or reaches a level within 10 percent of initial static water level.
- When measurements are terminated, the transducer shall be removed.
- Water level measurements recorded shall be checked for credibility before proceeding.

- Any test or test stage shall be repeated if review of the recorded data indicates questionable validity.

The data from the slug test will be reduced to evaluated time versus change in water level using the methods of Cooper, et al. (1967) or Bower and Rice (1976). Upon evaluating the results of the slug test, a pumping test plan may be developed.

4.6.3 Documentation

Water level data shall be recorded with the data logger and preserved for offloading at the Woodward-Clyde Consultants office in Baton Rouge, Louisiana. To the extent possible, print outs shall be obtained for each set of tests during the data checking phase of testing. Printouts obtained shall be properly labelled to indicated the following and shall be preserved as raw field data:

- Piezometer location
- Piezometer number
- Date of Test
- Elevation of Base of Test Section
- Elevation of Top of Test Section
- Testing Stage (i.e., slug-in or slug-out)

If a printout cannot be obtained, the data shall be hand recorded in the field log book, if possible or the piezometer will be retested.

PIEZOMETER INSTALLATION

Upon completion of the drilling and sampling as described above for borings designated for piezometer installation, shallow and/or deep piezometers may be installed at locations noted in Figures 2, 3, and 4.

5.1 EQUIPMENT

In addition to drilling and sampling equipment described in Section 1.1, the material required for installation will consist of:

- A screen to allow entry of ground water.
- A bentonite pellet seal above the filter pack to prevent downward migration into the filter media.
- A filter pack to fill the space between the borehole and the screen with a stable material and to limit entry of fine materials into the well.
- Blank pipe or casing connecting the screen to the ground surface.
- A low permeability grout seal between the casing and the borehole to isolate the screened interval from the ground surface.
- Intermediate casings to seal off permeable zones above the target stratum, as needed.
- A protective casing at the surface (for permanent piezometers).
- A surface slab (for permanent piezometers).
- Protective posts (for permanent piezometers).

5.1.1 Procedure

The construction for piezometer involves drilling of borehole to the total depth and backfilling the hole in succession with the screen (with a cap and sump on the bottom), the blank pipe above the screen, a filter pack around the screen, a bentonite pellet layer and cement bentonite grout to the surface.

In the event that it is necessary to "case off" contamination from being carried further subsurface, the following procedure may be followed. Such piezometers will be constructed by drilling a borehole through the base of the upper permeable zone and one to three feet, at the discretion of the qualified WCC representative, into the underlying clay. A Schedule 40 PVC casing is lowered into the borehole and pushed about one foot into the clay at the base of the boring. The casing is then grouted in place by pumping a cement bentonite grout through a tremie pipe into the borehole between the outer casing wall and borehole wall. At completion of the grouting, the grout is allowed to cure for 24 hours and the downhole drilling equipment is decontaminated. During the grout set period the casing will be capped to prevent tampering until well installation is resumed. After the grout has set, the inside of the 12 inch casing is thoroughly flushed with clean water. The borehole and installation are then completed through the casing. Piezometers will be surveyed upon completion prior to sampling.

Screen.

Screens will be 2-inch diameter Schedule 40 PVC with No. 10 slot size. Connections between the screen and the casing will be threaded. No glues, solvents, epoxies, thermal processes (except welding) or rivets will be used.

A direct measurement of borehole depth by the use of a clean, chemically inert, weighted measuring tape shall be made before screen placement. The depth, to the nearest tenth of a foot shall be recorded on the construction log.

The borehole shall be purged or flushed with water, to the extent practical of drill cuttings and any bentonite drilling mud used during construction. If during construction unstable soils or other factors resulting in side wall caving or "blow-in", were encountered, the use of temporary casing will be required. The temporary casing shall be steam cleaned and free of coatings and rinsed with water prior to use.

The screen shall be new, commercially fabricated continuously wound or slotted screen with a four-inch nominal diameter. No fittings shall obstruct the inside diameter. The screen will be free of foreign matter and steam cleaned prior to use.

Screens shall be 0.01 inch slot and no longer than 10 feet in length nor shorter than five feet. Screens will be placed based on the qualified WCC representative's description of formation materials.

Filter Pack.

After the screen is placed in the borehole the filter pack will be placed around it. The filter pack material will consist of a clean graded sand (typically 20-40 mesh sand).

None of the filter pack aggregate is to come in contact with the ground surface. Any aggregate that comes in contact with the ground surface or is otherwise contaminated shall not be introduced into the well. Filter aggregate may be placed directly from the bag; however, care will be exercised not to include the dust and fines from the bottom of the sack.

The filter pack is to be placed by either tremie pipe or poured down and around the annulus in such a manner as to be distributed around the screen at a uniform height and density.

If temporary casing is used, the filter pack will be placed first and then the casing partially withdrawn to allow the filter pack to slump against the side walls of the boring. Additional filter aggregate will be added to allow for the slight increase in volume.

The filter pack will extend 1 to 2 feet above the top of the screen unless this height prevents proper placement of the bentonite seal. Placement of an adequate bentonite seal shall override the filter pack thickness except that the filter pack will come at least one foot over the top of screen. In no case shall the filter pack extend such that separate permeable zones are connected.

Pipe and Casing.

Blank pipe or casing made of 2-inch diameter Schedule 40 PVC will extend from the top of the screen to between three and four feet above ground surface. This blank pipe will be attached to the screen by a threaded connection. The casing will be capped with a vented top cap.

Grout Seals.

A bentonite pellet seal shall be 2 or 3 feet in thickness and will be placed in such a manner as to be uniform in thickness around the casing. In placing the bentonite pellets, care will be exercised so as not to incorporate any of the accumulated bentonite fines from the bottom of the packaging container into the annulus.

However, if the soils in this area are unstable to the degree that slumping or collapse of these soils against the permanent wall casing is highly probable, then the bentonite pellet seal shall be placed first and the temporary casing withdrawn as expeditiously as practical. After placement of the bentonite seal, the seal will be given adequate time to hydrate as determined by the qualified WCC representative. After the hydration period, the top of the bentonite seal shall be determined by direct measurement and recorded on the construction log.

The annular space above the bentonite seal will be grouted. All grout materials shall be placed by pumping through rigid, side discharge tremie pipe.

Protective Casing

A 8-inch locking protective casing shall be placed around the PVC riser pipe as soon as possible after grout inspection has been completed. The protective casing shall be provided with a threaded, 1/4-inch hole and drain plug at a base of the exposed portion of the protective casing. The protective casing shall fit such that there is sufficient clearance for cap accessibility.

The inside of the locking cover of the protective casing shall have the following inscribed, stamped or otherwise permanently affixed:

- Identification number
- Top of casing elevation
- Depth
- Screen length
- Date of well installation

- Construction contractor's name

The locking protective casing, at a minimum, shall be five feet in length and extend just over the riser pipe, and be manufactured of new black iron, steel, or stainless steel pipe or will be protective covers commercially manufactured for that purpose. Prior to placement, the casing shall be steam cleaned and free of any asphaltic or resinous coatings except paint or primer applied by the manufacturer. The casing shall be provided with a locking cap that telescopes or in some similar manner extends over and down the casing to prevent the entrance of rainwater, wind-blown dust particles, or insects into the casing. All protective casings shall be provided with a padlock, which shall be locked until the time of sampling.

Surface Slab.

A concrete slab will be poured at the ground surface around each well after installation. The slab will be at least four inches thick and five feet square and sloped gently away from the well in all directions.

Protective Posts.

Wells located in areas of traffic will be further protected by the erection of four steel posts, or approved alternate, each radially located 4 feet from each well, placed 2 to 3 feet below ground surface, having 3 feet minimally above ground surface. Guard posts shall not be made a part of any protective slab constructed around the well.

5.1.2 Documentation

Each installed piezometer shall be depicted in an installation report. This report shall be attached to the boring log for that installation and shall graphically denote, by depth from ground surface (unless otherwise specified):

- The bottom of the boring (that part of the boring most deeply penetrated by drilling and/or sampling) and borehole diameter;
- Screen location;
- Granular filter pack;

- Bentonite pellet seal;
- Grout;
- Cave-in(s);
- Height of riser (without cap/plug) above ground surface;
- Protective casing detail;
 - height of protective casing without cap/cover
 - base of protective casing
 - drainage port location and size
 - guard post configuration

The construction report will include:

- The actual quantity and composition of the grout, seals, and granular filter pack used for each well.
- The screen slot size (in inches), outside diameter, schedule/thickness, composition, and manufacturer.
- The outside diameter, schedule/thickness, composition, and manufacturer of the well casing.
- The joint design and composition.
- Location of placement of bentonite pellet seal.
- Location of placement of annular grout.
- Protective casing composition and nominal inside diameter.
- Special problems and their resolutions; e.g., grout in wells, lost casing and/or screens, bridging, etc.
- Dates and times for the start and completion of well installation.

All abbreviations used on the boring logs/well diagrams shall be designated on the log-diagram or in an attached general legend.

6.0
DOCUMENTATION

For documentation purposes, all information pertinent to field observations and sampling will be recorded in a field logbook with consecutively numbered pages. Entries in the log book will include at least the following:

- Location and sampling activity and address,
- Purpose of sampling,
- Number and approximate volume of samples taken,
- Description of sampling point,
- Date and time of collection,
- Collector's sample identification number(s),
- Sample distribution (e.g., chemical laboratory, geotechnical laboratory, etc.),
- Sample preservation,
- Field observations,
- Any field measurements made, such as pH, temperature, specific conductivity, or other field parameters,
- Weather conditions.

The documentation in the log book will be sufficient to reconstruct the sampling situation without relying on the collector's memory.

6.1 BORING LOGS

Field boring logs of a type similar to that presented in Figure 5 will include at a minimum the following information for each boring location:

- Project name and number
- Boring number
- Location of boring (including measured offset and reason for offset)

- Drilling method
- Name of WCC representative

Each log will also include:

- Sample location number and depth
- Water levels and the respective times of each reading
- Description of subsurface materials using the Unified Soil Classification System (USCS) including classification, consistency, texture, plasticity, moisture content, color, stratification, etc.
- Sample recovery in inches
- Results of organic vapor monitoring, if required
- Sample interval

6.2 PIEZOMETER INSTALLATION/DEVELOPMENT REPORTS

A piezometer installation report will be completed for each newly installed piezometer at the site. Information on these reports shall include the screening interval, depth to sand pack and bentonite seal, and grout backfill. The report will be documented using a form as shown on Figure 7.

6.3 GROUNDWATER SAMPLING REPORT

A sample collection log specific to groundwater sampling will be completed for each monitor well sampled at the site. These reports shall include static groundwater elevation, volumes purged, weather conditions, etc. The report will be on a form similar to Figure 8.

6.4 SAMPLE CUSTODY DOCUMENTATION

Chain-of-custody will be maintained for each sample collected. The chain-of-custody will provide an accurate written record which can be used to trace the possession and holding of samples from the time of collection through data analysis and reporting. The following information will be specified for each sample on the chain-of-custody form:

- Sample number
- Sample date
- Sample time
- Sample location and depth where appropriate
- Analyses to be performed

The chain-of-custody form will be signed by the sample custodian. It will be placed in a water-tight plastic bag and taped to the underside of the lid of the cooler containing the samples designated on the form. The lid of the cooler will be securely taped shut and signed custody seals will be placed on the opening of the cooler lid to allow detection of any possible tampering. Upon arrival in the laboratory, samples will be received by the analytical laboratory representative. Samples contained in the shipment will be compared of the chain-of-custody form to verify that all samples designated have been received. Sample custody within the laboratory will be maintained on internal tracking forms.

The chain-of-custody procedures document sample possession from the time of collection to final disposition. A Sample Analysis Request Form will accompany the Chain-of-Custody form and will document the requested sample analysis.

For the purpose of these procedures, a sample is considered in custody if it is:

- In one's actual possession
- In view, after being in physical possession
- Locked so that no one can tamper with it, after having been in physical custody
- In a secured area, restricted to authorized personnel

A chain-of-custody record will be initiated in the field, and the original will accompany the samples with copies retained at intermediate steps.

Each time responsibility for custody of the sample changes, the new custodian will sign the record and denote the date. A copy of the signed record will be made and retained by the immediately previous custodian to allow tracking of sample possession. All changes of custody of samples must be a person-to-person change of physical possession.

6.5 ANALYSIS REQUEST

Analysis of the samples collected shall be in accordance with the EPA CLP protocol. All samples shipped for analytical testing shall be accompanied by a Chain-of-Custody form and Sample Analysis Request form for document requested analyses, a copy of which is presented as Figures 9 and 10, respectively.

DECONTAMINATION

Personnel will wear appropriate protective clothing during decontamination as required by the Health and Safety Plan. All protective equipment (gloves, boots, etc.) will be decontaminated after use or they will be disposed in drums, labeled, dated, and stored until disposed at an approved facility.

7.1 CROSS-CONTAMINATION CONTROL PROCEDURES

In order to minimize the possibility of cross-contamination, strict cross-contamination control procedures should be followed. These procedures include:

- Sample jars should be kept in limited access areas until used.
- Clean equipment should be wrapped in aluminum foil or plastic sheeting prior to use.
- Clean plastic sheeting shall be placed at the sampling area and all equipment should be placed on the sheets. This plastic shall be discarded after each use.
- Equipment refueling shall be performed in designated areas. These areas should be at a distance from any sampling points, to minimize the potential that vapors from fuel will affect sample quality.
- All purge water, decontamination water, and discarded gloves should be containerized for disposal.

To prevent contamination prior to drilling operations, the following will be applied:

- Only new materials will be used. Only bagged cement, powdered bentonite in bags or bentonite pellets in well protectors will be used.
- PVC pipe for riser and well screen will be cured and free of plasticizers and oils.

- Workers will wear clean cotton or surgical gloves when handling riser and well screen.
- Electrical tape will not be used to band pumps.

7.2 SAMPLING EQUIPMENT DECONTAMINATION

All equipment used to collect groundwater samples should be decontaminated prior to the collection of the samples and in between sample locations. Decontamination of this equipment will be accomplished by the following procedures:

- Wash equipment thoroughly with laboratory, phosphate free detergent (i.e., Alconox) and de-ionized water using a brush to remove any particular matter or surface film.
- Triple rinse equipment thoroughly with clean deionized water.
- Rinse equipment thoroughly with methanol.
- Triple rinse with clean deionized water.

In the event that metals become a primary concern, sampling equipment will be rinsed with HCl prior to the methanol rinse. The sampling equipment will be wrapped in aluminum foil or visqueen after decontamination until reuse. This equipment will be decontaminated in areas established near the perimeter of the sampling area. Rinsate samples will be collected as indicated in the Quality Assurance Plan.

7.3 PUMP DECONTAMINATION

If a monitor well has been purged or sampled using any of the pumps as discussed, the pumps used need to be decontaminated between sample points. Decontamination of the pumps includes washing with soap and rinsing the outside portion of the pumps (especially those pumps that are placed inside the wells) as well as running water through the pump. It is recommended that a sufficient volume of distilled water or de-ionized water be run through the pumps to clean them out.

7.4 DOWNHOLE EQUIPMENT DECONTAMINATION

The drilling rig with associated tools and all sampling equipment will be decontaminated before entering the site and leaving the site. Downhole equipment (i.e., augers, bits, samplers, etc.) will be cleaned between boring or other sampling locations at a decontamination/washdown pad. Wash water will be containerized or transported to the wastewater treatment facility.

The equipment will be cleaned as described below:

- The drill rig, all auger flights, auger bits, drilling rods, drill bits, core barrel samplers, Shelby tubes, or other parts of the drilling and well development equipment that will contact the soil or groundwater should be cleaned with a steam cleaner or hand washed with a brush and detergent to remove oil, grease, and any contamination that has accumulated on the equipment.
- Any sampling equipment which can be safely steam cleaned shall be decontaminated as described above.
- These units should then be rinsed thoroughly with potable water

8.1 ANALYTICAL PROCEDURES

Analytical methods to be used in the investigation will be in accordance with CLP procedures utilizing the following statements of work:

- SOW February 1988 (or more recent) for organics
- SOW July 1988 (or more recent) for inorganics
- SOW September 1986 (or more recent) for 2,3,7,8-TCDD

CLP procedures provide step by step guidelines and requirements for the analysis of TCL and TAL constituents, including detection limits as shown in Tables 2 and 3.

8.2 CALIBRATION PROCEDURES AND FREQUENCY

Measuring and test equipment used in the field and laboratory shall be controlled by a formal calibration program. The program shall provide equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Calibration of measuring and test equipment may be performed internally using in-house reference standards, or externally by agencies or manufacturers.

8.2.1 Calibration Procedures

Documented and approved procedures shall be used for calibrating measuring and test equipment. Whenever possible, widely accepted procedures, such as those published by the ASTI or U.S. EPA, or procedures provided by manufacturers in equipment manuals, shall be adopted.

Calibrated equipment shall be uniquely identified by using either the manufacturer's serial number, an equipment identification number, or other means. This identification, along with a label indicating when the next calibration is due (only for equipment not requiring daily

calibration), shall be attached to the equipment. If this is not possible, records traceable to the equipment shall be readily available for reference. It is the responsibility of all personnel to check the calibration status from the due date labels or records prior to using the equipment.

Measuring and test equipment shall be calibrated at prescribed intervals and/or as part of operational use. Frequency shall be based on the type of equipment, inherent stability, manufacturer's recommendations, values given in national standards, intended use, and experience. Equipment shall be calibrated, whenever possible, using reference standards having known relationships to nationally recognized standards (e.g., National Bureau of Standards) or accepted values of physical constants. If national standards do not exist, the basis for calibration shall be documented.

Reference standards (physical and chemical) shall be used only for calibration. Physical standards shall be stored separately from working measuring and test equipment. Equipment that fails calibration or becomes inoperable during use shall be removed from service and segregated to prevent inadvertent use and shall be tagged to indicate it is out of calibration.

Records shall be prepared and maintained for each piece of calibrated measuring and test equipment to indicate that established calibration procedures have been followed. Laboratory calibration records shall be maintained by the laboratory.

8.2.2 Field Equipment Calibration

Field calibration procedures will be performed on field instrumentation as follows:

- pH Meter - Premeasurement calibration and post-measurement verification using at least two standard buffer solutions for each sample tested. The buffer solutions should bracket the sample pH. The two measurements must be within ± 0.05 standard unit of buffer solution values.

- Conductivity Meter - Daily calibration using potassium chloride (KCl) standard solution. The meter measurement must read ± 10 percent of the standard to be considered in control.
- Temperature - Temperature is measured using a thermostat built into the conductivity meter. The readings will be checked at least once at the start of the field use of the instrument using a quality grade thermometer.
- OVA - The instrument will be calibrated daily to a methane in air standard.

Calibration of field equipment shall be documented in the field log book for reference and maintained in the project files.

8.2.3 Laboratory Equipment Calibration

Laboratory calibration procedures for analytical testing will be performed in accordance with SW-846, 3rd Edition and EPA CLP protocols, as appropriate.

DATA REDUCTION, REPORTING, AND VALIDATION

Data reduction, validation and reporting will follow strict guidelines as presented in this section. The only data that will be reported will be data that meet the record keeping, quality assurance/quality control criteria and reporting formats as defined in this QA Protocol. Laboratory data review will follow documented data validation procedures. Data will be classified as accepted (quantified), estimated (qualified), or rejected based upon the validation procedures. For samples where the analytical data have been rejected, a decision will be made as to whether the results are critical and resampling is required. Only data that are classified as quantified or qualified will be reported.

The following sections describe the procedures to be used in data reduction, validation and reporting of analytical data. All analytical concentration reports will be reported unambiguously as concentration in $\mu\text{g/L}$ or mg/L for aqueous samples.

9.1 DATA REDUCTION

All concentration associated with samples or prepared sample extracts or digestates will be taken directly from multiplied quantitation reports. Multiplied quantitation reports relate the instrumentally measured extract or digestate concentrations to those of the original sample. GC/MS concentration data will be taken, to the extent possible, directly from the data systems following an internal standard calibration for both the volatile and semivolatile base/neutral/acid compounds and following an external calibration for both the pesticide and herbicide compounds.

9.2 DATA REPORTING

The intention of these sampling data reporting procedures is to maintain accurate records of all samples taken and to follow the status of the sample location and analytical results, while minimizing the duplication of record keeping activities and the possibilities for errors.

The tabulation and flow of all data reporting information can be broken down into the following activities:

- Assignment of sample numbers, sample label preparation, and initial permanent record keeping,
- Preparation and labeling of all sample bottles,
- Sampling and in-the-field record keeping,
- Sample receiving and preparation for shipping, and
- Complete sample record book.

9.2.1 Sampling Record Keeping

Prior to collecting a group of samples, a sample coordinator will assign a sample number and a description to all samples to be collected within the group. Sample numbers will be assigned to all divisions of the original sample, all of which have the same identification number with letters denoting subset containers. The sample number and corresponding description will be entered into a permanent record book. The information in the record book will then be written onto the appropriate sample label. When written, the sample labels will be given to the individual responsible for preparing the sample bottles.

The typed/printed labels for a group of sequentially numbered samples and a copy of the data book pages that include these numbers will be given to the sample bottle preparer and/or the sampler. This individual is responsible for applying all labels on the appropriate types of bottles. The sample preparer may also be the person who will be doing the sampling. A copy of the data book pages that include information about the samples will also be given to the person doing the sampling in order to provide a list of samples to check off during the sampling activity.

The individual(s) doing the sampling is (are) responsible for verifying that each sample is put in the appropriate sample bottle. At the time of sampling this person must fill in the time sampled, the date sampled, and sign and complete the sample's label. By the end of the sampling day, the sampler must return all samples to the geologist or engineer, who will oversee preparation of the samples for shipment (i.e., review chain-of-custody forms, inspect packaging, etc.

The person responsible for shipping the full sample bottles will compare the sample bottles with the appropriate sample data book pages. This person will then prepare the samples for shipping. Chain-of-custody forms must be completed for each sample; the originals must be sent with the samples, and copies will be sent to the sample coordinator to include in the appropriate project files.

9.2.2 Sample Custody and Shipment

When the samples are ready to be sent to the laboratory, the sample coordinator will examine the samples and note their condition. Information including the date sampled, time sampled, and method of preservation, for each sample will be entered in the sample record book.

At the time the samples are shipped, the sample coordinator will have a copy of the pages in the sample record book that include information on the sample numbers and the corresponding information on the date sampled, time sampled, and the date shipped.

The chain-of-custody record will document the fact that the evidentiary integrity of the samples was maintained.

9.2.3 Laboratory Response

The laboratory will be responsible for reviewing all sample analyses according to their internal QA/QC procedures. Data validation will be completed by the laboratory prior to the delivery of the data package. Completed data packages will be available for review by the project data validation coordinator and the project QA officer who will also evaluate the laboratory's checks. Any problems will be resolved and all data will be validated before the data are reported.

Laboratory data for all CLP TCL and TAL parameters will be maintained sufficient to be able to generate the standard CLP forms, if necessary at a later date. The quality control data and sample data results will be presented in a concise and convenient tabulated summary. The calibration data, raw quality control data, and raw sample data will be sufficient to permit reproduction of the calculation of any of the reported values. In addition, routine laboratory reports will include the following:

- Chain-of-Custody Records
- Quality Control Summary
- Sample Data Results

When generated, each hard copy CLP data package will provide thorough coverage according to the following areas:

- Case Narrative
- Chain-of-Custody
- Quality Control Summary
- Sample Data Results
- Calibration Data
- Raw Quality Control Data
- Raw Sample Data

The case narrative will provide the following information:

- Sample Identification
- Parameters Characterized
- Analytical Methods Employed
- Any Deviation from the Project Work Plan
- All Problems Encountered
- Any Corrective Actions Taken

9.3 DATA VALIDATION

Data validation, according to Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-0050/80, Office of Monitoring System and Quality Assurance and Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. 20460, December 29, 1980), is "a systematic process for reviewing a body of data against a set of criteria to provide assurance that data are suitable for their intended use", and entails editing, screening, checking, auditing, verification, certification, and review.

The purpose of data validation is to determine if the data conform to specifications and are suitable for the intended project usage. Therefore, all data will be subjected to screening in terms of conformance to project specifications and suitability for use. After completing a sampling program, the field data package (calibration records, chain-of-custody, field logs, etc), will be reviewed for completeness and accuracy. Data validation of analytical data will be completed before any of the results are released. The validation process described below will be done separately from the laboratory performing the analytical work as a separate process from internal laboratory data validation.

The following is a brief description of the methods that will be used during validation of the CLP laboratory data. These data will be reported in a summary data package and evaluated for conformance to the analytical limits set forth in Functional Guidelines for Evaluating Organic Analyses (Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, February, 1988) and Functional Guidelines for Evaluating Inorganic Analyses (Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, July, 1988). These checks will be performed on all samples analyzed, and the results will be summarized in a report for each lot of reported sample data. Qualified data will be reported as such and the appropriate qualifiers will be used for reporting. Non-CLP data and CLP data reported without the CLP summary data packages will be reviewed with respect to holding times, initial and continuing calibrations, method blanks, laboratory control samples, samples, matrix spikes and matrix spike duplicates or duplicates.

If problems occur which would reject data, the following procedures should detect these problems and the problem data will not be reported. However, rejected data will be addressed in the validation report to evaluate completeness goals.

- Compile a list of all investigative samples.
- Compile a list of all QC samples, including but not limited to:
 - Trip blanks
 - Laboratory blanks
 - Laboratory duplicates
 - Performance samples
 - Matrix spikes
 - Matrix spike duplicates
 - Laboratory control spikes
 - Laboratory control spike duplicate
- Review chain-of-custody documents for completeness and correctness.
- Review laboratory analytical procedures and instrument performance criteria.
 - Sample media identification
 - Sample location and descriptions
 - Proper concentration units
 - Proper significant figures
- This data summary will be reviewed for potential data quality problems including:
 - Unexpected results
 - Common laboratory contaminants
 - Unusual spacial concentration/identification relationships
 - Samples in which dilution was necessary
 - Samples which may have exhibited "carry over"
- A sample summary will be prepared to assess precision, accuracy and completeness of the analytical data.
- Laboratory records and data package requirements will be checked to assess completeness of the data package.

Laboratory performance results will be documented from the validation procedures or from precision or accuracy evaluations. The validation personnel will provide a means to notify the laboratory and initiate the appropriate corrective actions.

Despite all efforts to achieve the objectives of the laboratory QA/QC plan, the potential for error exists in laboratory chemical analyses and in the data reporting process. Every reasonable effort will be made to compare and double-check data reported from the laboratory, data entered into the data management system and data subsequently reported in accordance with the procedures described herein.

All analytical results are to be classified as quantified, qualified or rejected through data validation activities. Quantified data are to be used in laboratory reports at the numerical value identified. Qualified data are to be used as an estimate and are not to be used as a quantitative measurement. Rejected data are not to be included in the analytical report. No further use for design or other activities is to be made on the basis of rejected data.

INTERNAL QUALITY CONTROL

10.1 DATA TRANSCRIPTION

All data transcriptions for final reports will be reviewed before reporting. Data transcription requirements may vary, but should be monitored in accordance with requirements for accuracy and legibility.

10.2 FIELD SAMPLING QUALITY CONTROL

Quality control for field sampling includes duplicate samples, field blanks and rinsate blanks. Steps and checks used to validate precision and accuracy of the measured parameters and to support the representativeness, comparability, and completeness of the work include:

- Description of the calibration of methods and instruments,
- Description of routine instrument checks (noise levels, drift, linearity, etc).,
- Documentation of traceability of instrument standards, samples and data,
- Documentation on analytical methodology and QC methodology,
- Description of applicable performance audits with appropriate audit materials,
- Description of controls for interference contaminants in analytical methods (use of reference blanks and check standards for method accuracy and precision),
- Description of levels of routine maintenance to verify analytical reliability, and
- Documentation of sample preservation and transport.

10.3 VERIFICATION AND REVIEW

The laboratory analyst should review data to verify that where appropriate, the laboratory:

- Calculates the recoveries of surrogate spikes,
- Verifies that there are no contaminants in all associated blanks,
- Compares samples and duplicates for matches in data results,
- Reviews surrogate and spike recovery data to make sure they are within quality acceptance limits,
- Verifies calibration performance for acceptability,
- Reviews and verifies instrument tuning,
- Reviews internal areas of response for acceptability.

Upon meeting all technical criteria, the sample folder will then be reviewed to:

- Make sure the surrogate recovery section has been completed
- Make sure that all analyzed compounds have been properly recorded
- Confirm identified sample spectra with standard spectra
- Verify accuracy of calculations on compound quantities.

The supervisor examines the entire sample folder to verify that all data transcriptions and documentation included meets WCC requirements. The supervisor also reviews all data enclosed to verify that the data transcriptions are error free and that all documents are legible and in contractual order.

The laboratory QA department performs the review of completed folders on a percent complete basis to verify that the data is present so the WCC can evaluate data quality.

PERFORMANCE AND SYSTEM AUDITS

In order to verify that procedures outlined in the Quality Assurance Plan and the Sampling Plan, performance and system audits should be conducted. Such audits help to verify that the integrity of the data and related information is maintained.

11.1 FIELD ACTIVITY AUDITS

A senior project personnel or designee should periodically conduct audits of the collection activities to verify that proper sampling protocol is being followed. Some of the items to evaluate include (but are not limited to): sampling operations, sampling labelling, sample handling, field notes, decontamination procedures, and chain-of-custody. The auditor will prepare a summary audit report containing the result of the evaluation and recommendations for any corrective actions.

At a minimum, the auditor will check the following items to determine the completeness and accuracy of field activities:

- **Sample Labels:** A selected number of sample labels will be examined to determine if they were filled out properly and completely.
- **Chain-of-Custody Procedures:** Several chain-of-custody records will be examined to determine if they were properly filled out; if parameters for analysis were properly identified; all custody transfers were documented; and date and time of transfer were recorded.
- **Field Notebooks:** The notebooks will be examined to determine if proper recording format is being followed; if all in situ measurements and field observations are being documented suitably to explain and reconstruct field activities.

Intermittent audits may be performed by members of the sampling team for each filed sampling task. one independent team member may audit other members who are performing a separate task (i.e., sample handling member may audit sample collection). Results of audits will be included as part of the interim progress reports to the U.S. EPA.

11.2 LABORATORY PERFORMANCE AUDITS

The performance of laboratories in the U.S. EPA Contract Laboratory Program is monitored by the agency by using quarterly blind performance samples. Should the laboratory employed to analyze groundwater samples be in the CLP, then acceptable results on the most recent quarterly blind performance evaluation sample will be accepted as demonstrating laboratory capability to perform volatile, semivolatile and pesticide/PCB analyses. Performance evaluation samples should be obtained from a commercial supplier for laboratories that are not part of the EPA Contract Laboratory Program.

An on-site laboratory evaluation helps to verify that all the necessary quality control is being applied by the laboratory in order to deliver a high quality product. One laboratory audit of each laboratory used for sample analysis may be performed during the program. An internal laboratory audit by the respective laboratory QA officer will be performed during the program.

Quality assurance evaluations allow the evaluators to determine that:

- The organization and personnel are qualified to perform assigned tasks.
- Adequate facilities and equipment are available.
- Complete documentation, including chain-of-custody of samples, is being implemented
- Required analytical methodology is being used.
- Adequate analytical quality control, calibration including reference samples, control charts, and documented corrective action measures, is being provided.
- Acceptable data handling, documentation techniques, and data review are being used.

As described above, audit results will be transmitted to the U.S. EPA in the interim progress reports.

PREVENTIVE MAINTENANCE

In order to timely and effectively complete a measurement effort, an attempt should be made to minimize downtime of all instrumentation. This is achieved by regular inspections of equipment and the availability of spare parts or supplemental instrumentation should the equipment fail.

WCC's preventative maintenance program is designed to minimize the down time of crucial sampling and/or analytical equipment due to expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas:

- Establishment of maintenance responsibilities
- Establishment of maintenance schedules for major and/or critical instrumentation and apparatus, and documentation of maintenance activities in equipment logs.
- Establishment of an adequate inventory of critical spare parts and equipment.

12.1 FIELD INSTRUMENTATION

All instrumentation to be used in collecting or testing the groundwater samples will be regularly serviced and at a minimum, inspected prior to going out in the field to collect samples.

When laboratory or field equipment is damaged or it cannot be verified that it will produce acceptable data, the equipment will be removed from service to be repaired or replaced. The equipment will not be returned to service until it has been verified that it is capable of producing acceptable data. Acceptable data as referenced here is data which meets quality assurance criteria for precision, accuracy, and representativeness. Equipment leased or purchased to replace damaged equipment shall be capable of producing equivalent data. The WCC site managers will be responsible for the repair and/or replacement of damaged field equipment and field equipment provided by its subcontractors.

If nonanalytical type field equipment is damaged, it will be repaired immediately such that work may progress, or be replaced with similar or equivalent equipment such that the project objectives and the approved work plan will be met. The laboratory manager and site manager will retain documentation for the repair and/or replacement of laboratory and field equipment, respectively. All notable problems with equipment will be included in the interim progress reports to the U.S. EPA.

12.2 ANALYTICAL INSTRUMENTATION

The laboratory is expected to maintain and inspect their equipment. Instrument redundancy, to the extent possible, coupled with an extensive stock of spare parts and expendable materials on-site will serve to minimize downtime.

Subcontract laboratories are inspected to verify that similar preventive maintenance programs are in operation, and are properly documented including the following:

- Accepting data with an acknowledged level of uncertainty.
- Resampling and analyzing.
- Recalibration of instruments using freshly prepared calibration standards.
- Replacement of solvent or other reagents that give unacceptable blank values.
- Additional training of laboratory personnel in correct implementation of sample preparation and analysis methods.

The laboratory manager will be responsible for the repair and/or replacement of damaged laboratory equipment.

CORRECTIVE ACTION

During the course of this investigation, it will be the responsibility of the supervisor and the sampling team members to see that all measurement and sampling procedures are followed as specified and that measurement data meet the prescribed acceptance criteria. In the event a problem is discovered, it is imperative that prompt and prescribed action to be taken to correct the problem. Corrective action will be initiated, for instance, if QC data are found to exceed acceptability limits.

Whenever corrective action is necessary to eliminate the cause of nonconformance, a closed-loop corrective action system will be used. As appropriate, the sample coordinator, analysis coordinator, or the program manager will verify that all of these steps are followed:

- The problem will be defined,
- Responsibility for investigating the problem will be assigned,
- The cause of the problem will be investigated and determined,
- A corrective action to eliminate the problem will be determined,
- Responsibility for implementing the corrective action will be assigned and accepted,
- The effectiveness of the corrective action will be established, and
- The fact that the corrective action has eliminated the problem will be verified.

13.1 CORRECTIVE ACTION FOR FIELD SITUATION

The need for corrective action will be identified as a result of the field audits previously described as well as by other means (e.g., equipment malfunction). If problems become apparent that are identified as originating in the field, corrective action will take place. If corrective action does not resolve the problem, appropriate personnel will be assigned to investigate and evaluate the cause of the problem. Once a corrective action is implemented, the effectiveness of the action will be verified.

13.2 CORRECTIVE ACTION FOR LABORATORY SITUATIONS

The need for corrective action resulting from QA audits will be initiated by the environmental programs coordinator in consultation with the environmental lab personnel. Corrective Action may include, but is not limited to :

- Accepting data with an acknowledged level of uncertainty,
- Resampling and analyzing,
- Recalibration of instruments using freshly prepared calibration standards,
- Replacement of solvent or other reagents that give unacceptable blank values,
- Additional training of laboratory personnel in correct implementation of sample preparation and analysis methods.

QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality Assurance reports will include a tabulation of the analytical data and an explanation of any sampling conditions or QA/QC problems and their possible effects on data quality. In addition, audit reports will be issued as appropriate

14.1 ANALYTICAL QA REPORTS

The laboratory analytical program manager, laboratory QA coordinators, QA officer, and the data validation coordinator will communicate as needed to verify that all QA/QC practices are being carried out and to review possible or potential problem areas. Data anomalies are to be investigated to assess whether they are a result of operator or instrument deviation, or if they are a true reflection of the site or task function.

Final analytical reports will contain a discussion of QA/QC evaluations summarizing the quality of the data collected an/or used as appropriate to each phase of the project. The objective of the project QA/QC summary will be to ensure that the data are sufficient in quality and quantity to support the remedial alternative. The QA/QC summary will include:

- Tabulated results of the analytical data.
- A report from the QA officer evaluating the results of field and laboratory audits as described in Section 11.0.
- As tabulation of the data validation work sheets for each batch analysis from the data validation personnel evaluating the validity of the analytical data with respect to accuracy, precision, and completeness.
- A summary of significant QA problems with the corrective actions taken to rectify the situation.
- A report by the QA officer summarizing the validity of the analytical data with respect to accuracy, precision, completeness, representativeness, and comparability.

14.2 AUDIT REPORTS

Audit reports will be issued upon completion of any audits. These reports will describe the person involved with audits, what was being audited, and the findings of the audit. Any follow-up or repeat audit to verify corrective action will also be reported.

TABLES

TABLE 1
QUALITY CONTROL LEVEL OF EFFORT

PARAMETERS		FREQUENCY OF EPA CLP ANALYSIS	FREQUENCY FOR SW846 ANALYSIS
Cyanide	Calibration Blank	One per analytical run or at least one per setup	One per analytical run or at least one per setup
	Matrix Spike Analysis	One per analytical run or at least one per setup	One per analytical run or at least one per setup
	Duplicate Sample Analysis	One per analytical run or at least one per setup	One per analytical run or at least one per setup
	Laboratory QC Sample Analysis	One per analytical run or at least one per setup	One per analytical run or at least one per setup
Organics (GC/MS)	Laboratory Blank	One per case or one per 20 samples received	One per case or one per 20 samples received
	Matrix Spike Analysis	One per case or one per 20 samples received	One per case or one per 20 samples received
	Matrix Spike Duplicate Analysis	One per case or one per 20 samples received	One per case or one per 20 samples received
	Surrogate Spike	Each sample	Each sample

TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CRQL)*

Volatile Organics	Quantitation Limits ^a	
	Groundwater $\mu\text{g/L}$	Low Soil/Sediment $\mu\text{g/Kg}^b$
Chloromethane	10	10
Bromomethane	10	10
Vinyl Chloride	10	10
Chloroethane	10	10
Methylene Chloride	5	5
Acetone	10	10
Carbon Disulfide	5	5
1,1-Dichloroethene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethene (Total)	5	5
Chloroform	5	5
1,2-Dichloroethane	5	5
2-Butanone	10	10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate	10	10
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
cis-1,3-Dichloropropane	5	5
Trichloroethene	5	5
Dibromochloromethane	5	5
1,1,2-Trichloroethane	5	5

**TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CRQL)***

Volatile Organics	Quantitation Limits ^a	
	Groundwater μg/L	Low Soil/Sediment μg/Kg ^b
Benzene	5	5
trans-1,2-Dichloropropane	5	5
Bromoform	5	5
4-Methyl-2-pentanone	10	10
2-hexanone	10	10
Tetrachloroethene	5	5
Toluene	5	5
1,1,2,2-Tetrachloroethane	5	5
Chlorobenzene	5	5
Ethyl Benzene	5	5
Styrene	5	5
Xylenes (Total)	5	5

Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRDL.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

Source: Statement of Work for Organic Analysis Multi-Media Multi-Concentration SOW 2/88, Revisions 9/88, 4/89, and 5/89, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., May 1989.

TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CRQL)^a

Semivolatile Organics	Quantitation Limits ^a	
	Groundwater µg/L	Low Soil/Sediment µg/Kg ^b
Phenol	10	330
bis-2-Chloroethyl)ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl Alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl)ether	10	330
4-Methylphenol	10	330
N-Nitro-di-n-dipropylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic Acid	50	1600
bis(2-Chloroethoxy)methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330

TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CRQL)*

Semivolatile Organics	Quantitation Limits ^a	
	Groundwater $\mu\text{g/L}$	Low Soil/Sediment $\mu\text{g/Kg}^b$
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1600
2-Chloronaphthalene	10	330
2-Nitroaniline	50	1600
Dimethylphthalate	10	330
Acenaphthylene	10	330
2,6-Dinitrotoluene	10	330
3-Nitroaniline	50	1600
Acenaphthene	10	330
2,4-Dinitrophenol	50	1600
4-Nitrophenol	50	1600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
Diethylphthalate	10	330
4-Chlorophenyl-phenyl-ether	10	330
Fluorene	10	330

TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CRQL)*

Semivolatile Organics	Quantitation Limits*	
	Groundwater µg/L	Low Soil/Sediment µg/Kg ^b
4-Nitroaniline	50	1600
4,6-Dinitro-2-methylphenol	50	1600
N-Nitrosodiphenylamine	10	330
4-Bromophenyl-phenylether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	50	1600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butylphthalate	10	330
Fluoranthene	10	330
Pyrene	10	330
Butyl Benzyl Phthalate	10	330
3,3'-Dichlorobenzidine	20	660
Benzo(a)anthracene	10	330
Chrysene	10	330
bis(2-Ethylhexyl)phthalate	10	330
Di-n-octylphthalate	10	330
Benzo-(b)fluoranthene	10	330
Benzo-(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330

**TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CRQL)***

Semivolatile Organics	Quantitation Limits ^a	
	Groundwater $\mu\text{g/L}$	Low Soil/Sediment $\mu\text{g/Kg}^b$
Dibenz(a,h)anthracene	10 / /	330
Benzo(g,h,i)perylene	10 / /	330

- Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.
- Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRDL.
- Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

Source: Statement of Work for Organic Analysis Multi-Media Multi-Concentration SOW 2/88, Revisions 9/88, 4/89, and 5/89, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., May 1989.

**TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CROL)***

Pesticide/PCBs	Quantitation Limits*	
	Groundwater $\mu\text{g/L}$	Low Soil/Sediment $\mu\text{g/Kg}^b$
alpha-BHC	0.05	8.0
beta-BH	0.05	8.0
delta-BHC	0.05	8.0
gamma-BHC	0.05	8.0
Heptachlor	0.05	8.0
Aldrin	0.05	8.0
Heptachlor Epoxide	0.05	8.0
Endosulfan I	0.05	8.0
Dieldrin	0.10	16.0
4,4'-DDE	0.10	16.0
Endrin	0.10	16.0
Endosulfan II	0.10	16.0
4,4'DDD	0.10	16.0
Endosulfan Sulfate	0.10	16.0
4,4'-DDT	0.10	16.0
Methoxychlor	0.05	80.0
Endrin ketone	0.10	16.0
alpha-Chlordane	0.05	80.0
gamma-Chlordane	0.05	80.0
Toxaphene	1.0	160.0
Aroclor-1242	0.5	80.0
Aroclor-1248	0.5	80.0

**TABLE 2
TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMIT (CRQL)***

Pesticide/PCBs	Quantitation Limits ^a	
	Groundwater μg/L	Low Soil/Sediment μg/Kg ^b
Aroclor-1061	0.5	80.0
Aroclor-1221	0.5	80.0
Aroclor-1232	0.5	80.0
Aroclor-1254	1.0	160.0
Aroclor-1260	1.0	160.0

Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Medium Soil/Sediment Contract Required Quantitation Limits (CRQL) for Volatile TCL Compounds are 125 times the individual Low Soil/Sediment CRDL.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

Source: Statement of Work for Organic Analysis Multi-Media Multi-Concentration
SOW 2/88, Revisions 9/88, 4/89, and 5/89, Office of Solid Waste and
Emergency Response, U.S. Environmental Protection Agency, Washington,
D.C., May 1989.

**TABLE 3
TARGET ANALYTE LIST (TAL) INORGANICS**

Analyte	Contract Required Detection Limits [*] ($\mu\text{g/l}$)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

* The reporting limits are instrument detection limits obtained in pure water. The detection limits for samples may be considerably higher depending on the sample matrix.

Source: Statement of Work for Inorganic Analysis Multi-Media Multi-Concentration, SOW No. 788, Revisions 2/89 and 6/89, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency

**TABLE 4
DETECTION LIMITS FOR METALS¹**

Metal	Nominal Water Detection Limit, mg/L			
	Flame AA	Furnace AA	Other AA	ICP
Aluminum	0.1	0.003	—	0.05*
Antimony	0.2	0.002**	—	0.30*
Arsenic	0.5	0.002*	0.002	0.05*
Barium	0.1	0.002	—	0.005*
Beryllium	0.002	0.0001	—	0.001*
Cadmium	0.005	0.0001**	—	0.002*
Calcium	0.01	—	—	0.01*
Chromium	0.05	0.001	—	0.005*
Cobalt	0.05	0.001	—	0.003*
Copper	0.02	0.001	—	0.002*
Iron	0.03	0.001	—	0.01*
Lead	0.1	0.001*	—	0.02
Magnesium	0.05	0.001	—	0.1*
Manganese	0.01	0.0002	—	0.005*
Mercury	—	—	0.00002*	—
Nickel	0.04	0.001	—	0.01*
Potassium	0.01	—	—	0.3*
Selenium	—	0.002*	0.002	0.075
Silver	0.01	0.0001**	—	0.003*
Sodium	0.002	—	—	0.5*
Thallium	0.1	0.001*	—	0.040
Tin	1	0.05	—	0.03*
Vanadium	0.2	0.004	—	0.002*
Zinc	0.005	0.00005	—	0.004*

- Recommended method for analyses (RMAL).
- More sensitive method sometimes used.
- ¹ Based upon SW846, 3rd Edition Methods

DRAFT

TABLE 5
PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES

Measurement Parameters	Experimental Conditions	Surrogate Percent Recovery	Precision (Relative Percent Difference)	Accuracy (Percent Recovery)	Completeness (Percent)	Other EPA CLP Control Limits
Volatile (Purgeable) Organic Target Compounds ¹	Spiked and unspiked field samples	Compound Specific ²	Compound Specific ²	Compound Specific ²	90	Laboratory Blank: \pm D.L. Laboratory Duplicate: $\pm 35\%$ RPD Initial Calibration: $RRF^{(4)} > .05$ and $\leq 30\%$ RSD ⁽³⁾ Continuing Calibration: $> .05$ RRF and $\leq 25\%$ D ⁽⁴⁾ Internal Standard GC/MS: -50 to + 100%
Semivolatile (Base/Neutral and Acid) Organic Target Compounds ¹	Spike and unspiked field samples	Compound Specific ²	Compound Specific ²	Compound Specific ²	90	Laboratory Blank: \pm D.L. Laboratory Duplicate: $\pm 35\%$ RPD Initial Calibration: $RRF^{(4)} > .05$ and $\leq 30\%$ RSD ⁽³⁾ Continuing Calibration: $> .05$ RRF and $\leq 25\%$ D ⁽⁴⁾ Internal Standard GC/MS: -50 to + 100%
Pesticides and PCBs ¹	Spiked and unspiked field samples	Compound Specific ²	Compound Specific ²	Compound Specific ²	90	Laboratory Blank: \pm D.L. Laboratory Duplicate: $\pm 35\%$ RPD Initial Calibration: 10% RSD Continuing Calibration: 15 or 20% RSD DDT/Endrin Degradation: <20%

TABLE 5
PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES

Measurement Parameters	Experimental Conditions	Surrogate Percent Recovery	Precision (Relative Percent Difference)	Accuracy (Percent Recovery)	Completeness (Percent)	Other EPA CLP Control Limits
Mercury ^a	Spiked and Unspiked filed samples		±20 percent provided both sample and duplicate greater than 5 times CRDL ±CRDL if either sample or duplicate less than CRDL	75 to 125 percent unless the sample exceeds the spike concentration by a factor of four or more Not calculated if sample concentration exceeds spike concentration by a factor of four or more	90	Calibration Blank: ±D.L. Calibration Verification: 80-120% Preparation Blank: ±D.L. Duplicate Sample Analysis: ±D.L. or 20%RPD Lab QC Sample Analysis: 80-120%
Cyanide, Total ^a	Spike and unspiked field samples		±20 percent provided both sample and duplicate greater than 5 times CRDL ±CRDL if either sample or duplicate less than CRDL	75 to 125 percent unless the sample exceeds the spike concentration by a factor of four or more	90	Calibration Blank: ±D.L. Calibration Verification: 85-115% Preparation Blank: ±D.L. Duplicate Sample Analysis: ±D.L. or 20%RPD Lab QC Sample Analysis: 80-120%
Target Analyte List (TAL) Metals Other than Mercury ^a	Spiked and unspiked field samples		±20 percent provided both sample and duplicate greater than 5 times CRDL ±CRDL if either sample or duplicate less than 5 times CRDL	75 to 125 percent unless the sample exceeds the spike concentration by a factor of four or more Not calculated if sample concentration exceeds spike concentration by a factor of four or more	90	Calibration Blank: ±D.L. Calibration Verification: 90-110% Preparation Blank: ±D.L. Duplicate Sample Analysis: ±D.L. or 20%RPD Lab QC Sample Analysis: 85-115%

TABLE 5 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES						
Measurement Parameters	Experimental Conditions	Surrogate Percent Recovery	Precision (Relative Percent Difference)	Accuracy (Percent Recovery)	Completeness (Percent)	Other EPA CLP Control Limits
Restricted Target Analyte List (TAL) Metals ¹ Calcium Magnesium Potassium Sodium	Unspiked field samples		±20 percent provided both sample and duplicate greater than 5 times CRDL ±CRDL if either sample or duplicate less than CRDL	Not applicable. Matrix spikes not employed with these analytes.	90	Calibration Blank: ±D.L. Calibration Verification: 90-110% Preparation Blank: ±D.L. Duplicate Sample Analysis: ±D.L. or 20%RPD Lab QC Sample Analysis: 85-115%

¹ See Table XX for an enumeration of the Target Compound List (TCL) parameters and Contract Required Quantitation Limits (CRQLs).

² See Table XX for an enumeration of spike surrogate compounds and control limits.

³ See Table XX for an enumeration of matrix spike compounds and control limits.

⁴ See Table XX for an enumeration of the Target Analyte List (TAL) parameters and Contract Required Detection Limits (CRQLs).

Abbreviations:

AA Atomic Adsorption
 CRDL Contract Required Detection Limit
 D.L. Diction Limit
 D Percent Difference
 ICP Inductively Coupled Plasma
 RPD Relative Percent Difference

TABLE 6

SURROGATE SPIKE RECOVERY LIMITS

ANALYTICAL FRACTION	SURROGATE COMPOUND	RECOVERY LIMITS (%)
Volatile	4-Bromofluorobenzene	86 - 115
	1,2-Dichloroethane-d ₄	76 - 114
	Toluene-d ₈	88 - 110
Base/Neutral	Nitrobenzene-d ₅	35 - 114
	2-Fluorobiphenyl	43 - 116
	p-Terphenyl-d ₁₄	33 - 141
Acid	Phenol-d ₆	10 - 94
	2-Fluorophenol	21 - 100
	2,4,6-Tribromophenol	10 - 123
Pesticide	Dibutylchlorodate ¹	24 - 154

¹ Recovery limits are for advisory purposes only. They are not used to determine if a sample should be reanalyzed.

Source: Statement of Work for Organic Analysis Multi-Media Multi-Concentration, SOW 2/88, Revisions 9/8, 4/89 and 5/89, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., May, 1989.

TABLE 7

**MATRIX SPIKE RECOVERY AND RELATIVE PERCENT DIFFERENCE
CONTROL LIMITS**

ANALYTICAL CATEGORY	MATRIX SPIKE COMPOUND	RELATIVE PERCENT DIFFERENCE	RECOVERY LIMITS (%)
Volatile	1,1-Dichloroethene	14	61 - 145
	Trichloroethene	14	71 - 120
	Chlorobenzene	13	75 - 130
	Toluene	13	76 - 125
	Benzene	11	76 - 127
Base/Neutral	1,2,4-Trichlorobenzene	28	39 - 98
	Acenaphthene	31	46 - 118
	2,4-Dinitrotoluene	38	24 - 96
	Di-n-Butylphthalate	40	11 - 117
	Pyrene	31	26 - 127
	N-Nitroso-Di-n-Propylamine	38	41 - 116
	1,4-Dichlorobenzene	28	36 - 97
Acid	Pentachlorophenol	50	9 - 103
	Phenol	42	12 - 89
	2-Chlorophenol	40	27 - 123
	4-Chloro-3-Methylphenol	42	23 - 97
	4-Nitrophenol	50	10 - 80
Pesticide	Lindane	15	56 - 123
	Heptachlor	20	40 - 131
	Aldrin	22	40 - 120

TABLE 7

MATRIX SPIKE RECOVERY AND RELATIVE PERCENT DIFFERENCE
CONTROL LIMITS

ANALYTICAL CATEGORY	MATRIX SPIKE COMPOUND	RELATIVE PERCENT DIFFERENCE	RECOVERY LIMITS (%)
	Dieldrin	18\	52 - 126
	Endrin	/21\	56 - 121
	4,4'-DDT	/27\	38 - 127

Source:

Statement of Work for Organic Analysis Multi-Media Multi Concentration
SOW 2/88, Revisions 9/88, 4/89 and 5/89, Office of Solid Waste and
Emergency Response, U.S. Environmental Protection Agency, Washington,
D.C., May, 1989.

TABLE 8
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Container	Preservation	Holding Time
Total Dissolved Solids (TDS)	1,000-ml glass wide-mouth bottle with teflon-lined screw closure, or high density polyethylene bottle	Cool, 4°C	48 hours after collection
Total Organic Carbon (TOC)	500-ml glass bottle cleaned according to Protocol A or B	Cool, 4°C, H ₂ SO ₄ to pH < 2	28 days after collection
Volatiles	Two 40-ml glass vials with teflon-faced silicone septa with open top polyethylene screw closure cleaned according to Protocol B	Cool, 4°C HCl to pH < 2 Zero Headspace	7 days after collection
		Cool, 4°C Zero Headspace	14 days after collection
Semivolatiles	Two 1,000-ml amber glass wide-mouth bottles with teflon-lined screw closures cleaned according to Protocol A	Cool, 4°C	7 days after collection 40 days after extraction
Chlorides	1,000-ml glass wide-mouth bottle with teflon-lined screw closure or high density polyethylene bottle cleaned according to Protocol A or C	Cool, 4°C	28 days after collection

TABLE 8
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Container	Preservation	Holding Time
Metals	1,000-ml glass wide-mouth bottle with teflon-lined screw closure or high density polyethylene bottle cleaned according to Protocol A	HNO_3 to pH < 2	Mercury: 28 days after collection Other Metals: 180 days after collection
Pesticides/PCBs	Two 1,000-ml amber glass wide-mouth bottles with teflon-lined screw closures cleaned according to Protocol A	Cool, 4°C	7 days after collection 40 days after extraction
Nitrate/Nitrite¹	500-ml glass wide-mouth bottle with teflon-lined screw closure or high density polyethylene bottle cleaned according to Protocol B	Cool, 4°C H_2SO_4 to pH < 2	28 days after collection
Radionuclides	Three 1,000-ml glass wide-mouth bottles with teflon-faced screw closure or high density polyethylene bottle cleaned according to Protocol A	HNO_3 to pH < 2	180 days after collection

TABLE 8
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Parameter	Container	Preservation	Holding Time
Extractables BNA	Four 1,000-ml amber glass wide-mouth bottles with teflon-lined screw closures	Cool, 4°C	7 days after collection 40 days after extraction
Oil and Grease	1,000-ml amber glass wide-mouth bottles with teflon-lined screw closures	Cool, 4°C	28 days after collection
BOD ₅	500-ml glass wide-mouth bottle with teflon-lined screw closure, or high density polyethylene bottle	Cool, 4°C	48 hours after collection
Total Suspended Solids (TSS)	1,000-ml glass wide-mouth bottle with teflon-lined screw closure, or high density polyethylene bottle	Cool, 4°C	7 days after collection
Sulfates	1,000-ml glass wide-mouth bottle with teflon-lined screw closure or high density polyethylene bottle	Cool, 4°C	28 days after collection
pH	1,000-ml glass wide-mouth bottle with teflon-lined screw closure or high density polyethylene bottle	Cool, 4°C	immediately upon receipt

TABLE 9				
FIELD QUALITY CONTROL SAMPLE FREQUENCY GROUNDWATER MONITOR WELLS ⁽¹⁾				
MATRIX	FIELD DUPLICATE	RINSATE BLANK	TRIP ⁽²⁾ BLANK	MS/MSD ³
Ground Water	1	1	1	1
Analytical Parameter	All Parameters	VOA and Semi Volatile	VOA	Spike

¹ There are less than 20 monitor wells. A sampling event or sample delivery group shall consist of a groundwater sample from each well plus the 5 quality control samples.

² Trip blanks will be prepared by the laboratory and shipped with the sample containers. One trip blank will be kept with the collected samples and shipped back to the laboratory in the last shipment.

³ Matrix Spiked/Matrix Spiked Duplicate samples will be spiked in the laboratory.

TABLE 10
DFTPP AND BFB TUNING AND CALIBRATION CRITERIA

EXTRACTABLE ORGANICS (DFTPP)	EPA CLP ORGANIC ANALYSIS¹		SW846 ORGANIC ANALYSIS²
51	30.0 - 60.0% of m/z 198		30.0 - 60.0% of m/z 198
68	<2.0% of m/z 69		<2.0% of m/z 69
70	<2.0% of m/z 69		<2.0% of m/z 69
127	40.0 - 60.0% of m/z 198		40.0 - 60.0% of m/z 198
197	<1.0% of m/z 198		<1.0% of m/z 198
198	base peak, 100% relative abundance		base peak, 100% relative abundance
199	5.0 - 9.0% of m/z 198 ³		5.0 - 9.0% of m/z 198
275	10.0 - 30.0% of m/z 198		10.0 - 30.0% of m/z 198
365	>1.0% of m/z 198		>1.0% of m/z 198
441	present, but less than m/z 443		present, but less than m/z 443
442	>40.0% of m/z 198		>40.0% of m/z 198
443	17.0 - 23.0% of m/z 442		17.0 - 23.0% of m/z 442
VOLATILE ORGANICS (BFB)			
50	15.0 - 40.0% of the base peak		15.0 - 40.0% of the base peak
75	30.0 - 60.0% of the base peak		30.0 - 60.0% of the base peak

TABLE 10		
DFTPP AND BFB TUNING AND CALIBRATION CRITERIA		
	EPA CLP ORGANIC ANALYSIS ¹	SW846 ORGANIC ANALYSIS ²
95	base peak, 100% relative abundance	base peak, 100% relative abundance
96	5.0 - 9.0% of the base peak	5.0 - 9.0% of the base peak
173	<2.0% of m/z 174	<1.0% of the base peak
174	>50.0% of the base peak	>50.0% of the base peak
175	5.0 - 9.0% of m/z 174	5.0 - 9.0% of m/z 174
176	>95.0%, but less than 101.0% of m/z 174	>95.0%, but less than
177	5.0 - 9.0% of m/z 176	5.0 - 9.0% of m/z 176

Source: ¹Statement of work for Organic Analysis Multi-Media Multi-Concentration, SOW 2/88, Revisions 9/88, 4/89 and 5/89, Office of Solid Waste and Emergency Response, U.S. Environmental Protective Agency, Washington, D.C., May, 1989.

²SW846, 3rd Edition

TABLE 11
ANALYTICAL METHOD SUMMARY

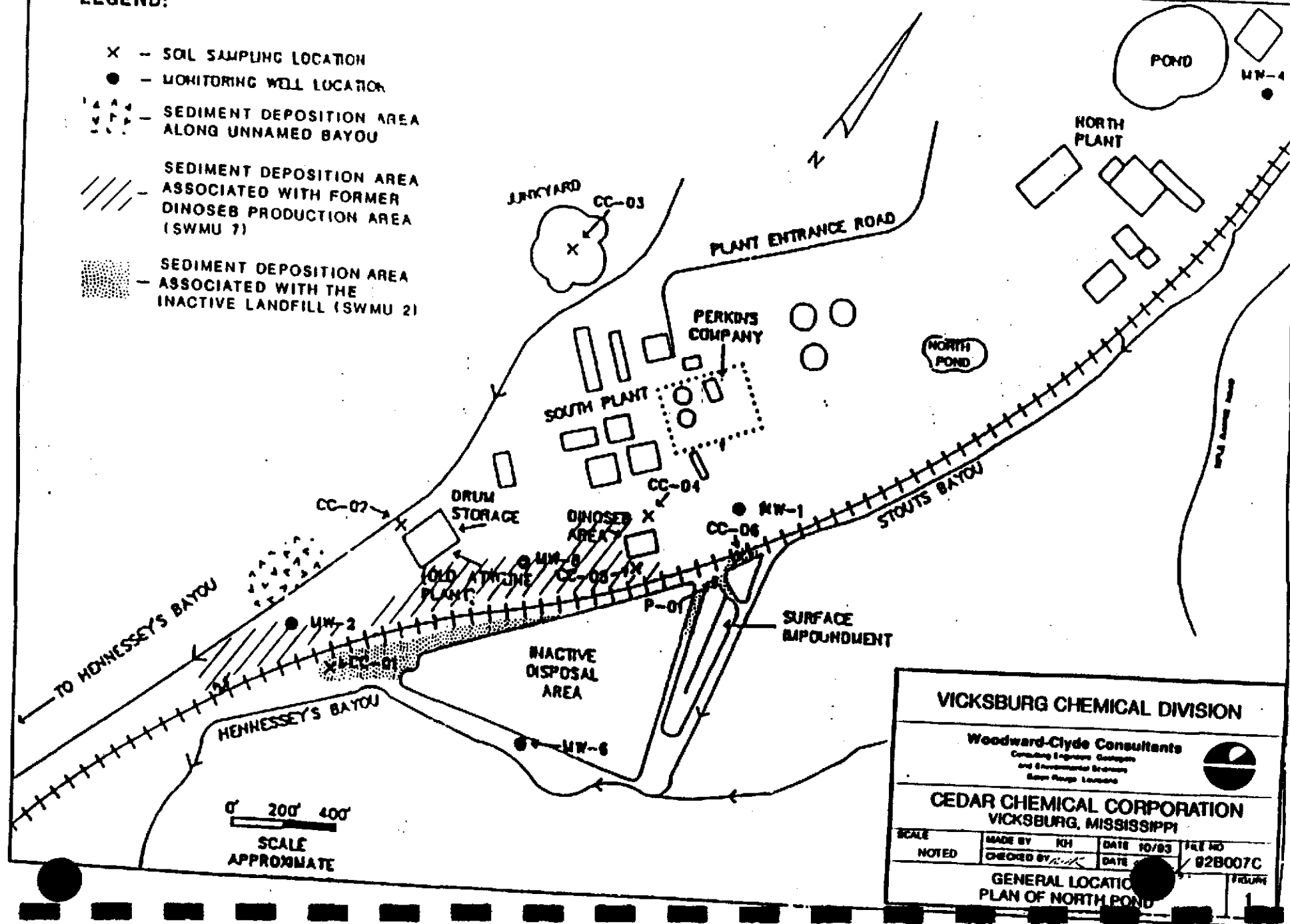
Category/Parameter	Method	Reference
TCL	EPA CLP SOW 2/88	1
TAL	EPA CLP SOW 7/88	2
BOD ₅	SW846 or Equivalent Method	3
TSS	SW846 or Equivalent Method	3
TOC	SW846 or Equivalent Method	3
TDS	SW846 or Equivalent Method	3
pH	SW846 or Equivalent Method	3

1. Statement of Work for Organic Analysis Multi-Media Multi-Concentration, SOW 2/88, Revision 9/88, 4/89, and 5/89, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., May 1989.
2. Statement of Work for Inorganic Analysis Multi-Media Multi-Concentration, SOW No. 788, Revisions 2/89 and 6/89, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., June 1989.
3. SW-846 Methods, from 3rd Edition or equivalent EPA Method.

FIGURES

LEGEND:

- X - SOIL SAMPLING LOCATION
- - MONITORING WELL LOCATION
- ▲▲▲ - SEDIMENT DEPOSITION AREA ALONG UNNAMED BAYOU
- //// - SEDIMENT DEPOSITION AREA ASSOCIATED WITH FORMER DINOSEB PRODUCTION AREA (SWMU 7)
- - SEDIMENT DEPOSITION AREA ASSOCIATED WITH THE INACTIVE LANDFILL (SWMU 2)



VICKSBURG CHEMICAL DIVISION

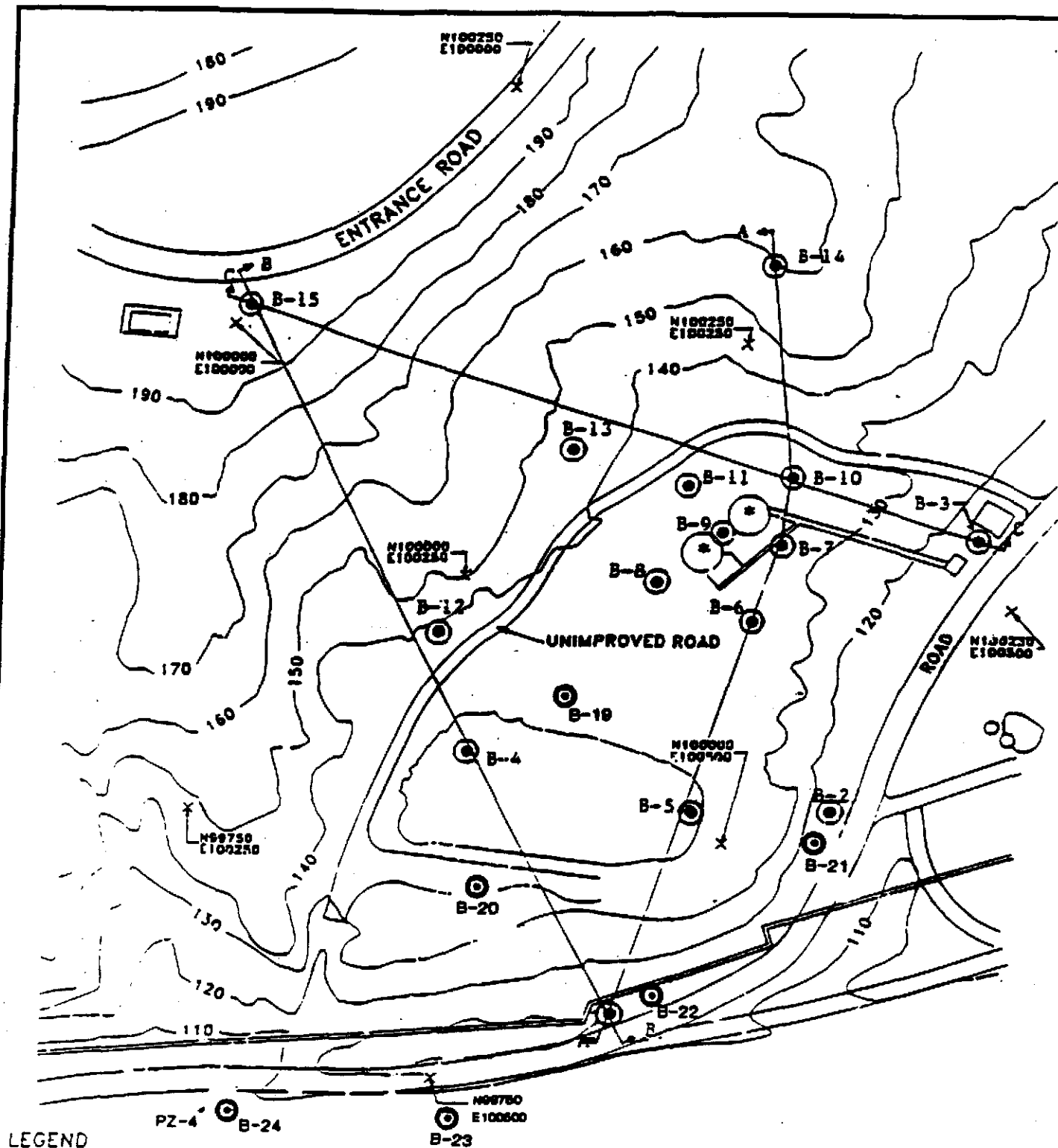
Woodward-Clyde Consultants
Consulting Engineers Geologists
and Environmental Scientists
Baton Rouge, Louisiana

CEDAR CHEMICAL CORPORATION
VICKSBURG, MISSISSIPPI

SCALE	MADE BY KH	DATE 10/83	FILE NO
NOTED	CHECKED BY	DATE	02B007C

GENERAL LOCATION
PLAN OF NORTH POND

FIGURE 1



REFERENCE : SOIL TESTING ENGINEERS, INC.
FILE NO. 93-3076

SCALE

100 0 100 200 FEET

**CEDAR CHEMICAL
VICKSBURG, MISSISSIPPI**

Woodward-Clyde Consultants
Consulting Engineers, Geologists
and Environmental Scientists
Baton Rouge, Louisiana

SCALE:
NOTED

DRAWN BY: KH
CHKD. BY: ROK

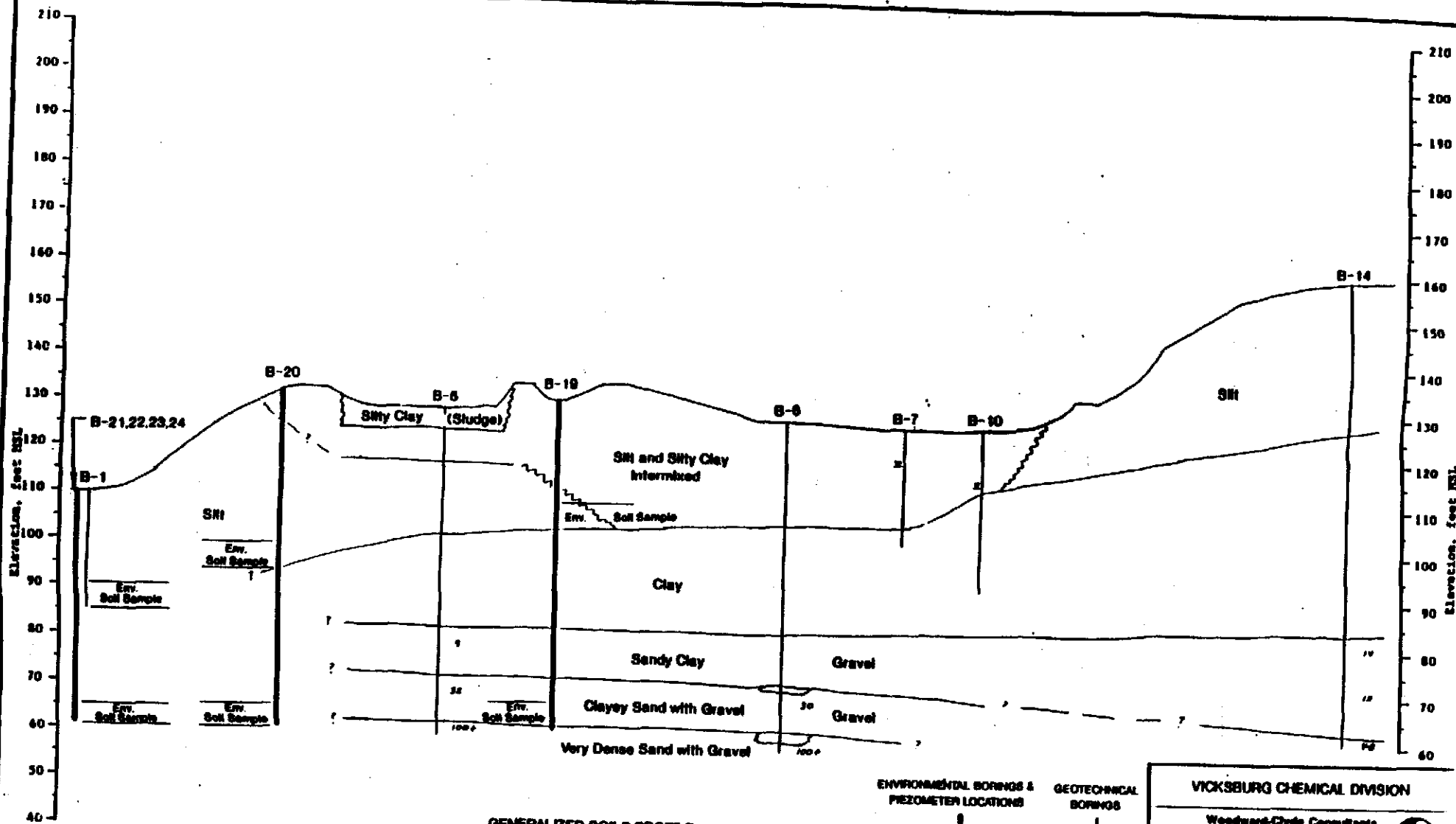
DATE: 10/93
DATE: 11/22/93

FILE NO.

92B007C

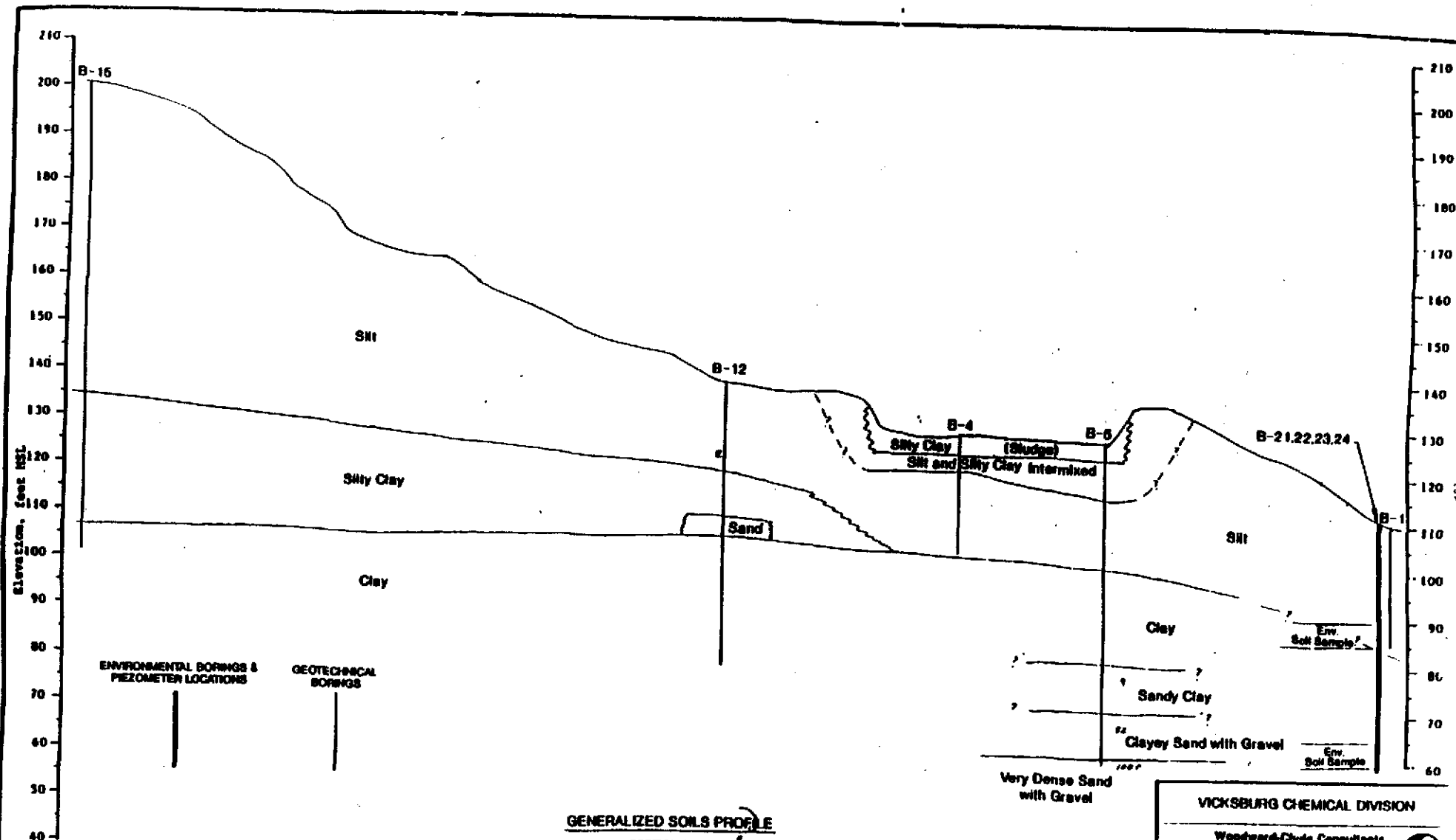
FIG. NO.

2



STE
 Soil Testing Engineers, Inc.

VICKSBURG CHEMICAL DIVISION			
Woodward-Clyde Consultants Consulting Engineers, Geologists and Environmental Scientists Baton Rouge, Louisiana			
CEDAR CHEMICAL CORPORATION VICKSBURG, MISSISSIPPI			
SCALE	DATE	DATE	FILE NO.
NOTES	CHANGED	DATE	628007C
			1/20/78
			3



STE
Soil Testing Engineers, Inc.

GENERALIZED SOILS PROFILE

SECTION B-B
Horizontal Scale: 1"=40'
Vertical Scale: 1"=20'

VICKSBURG CHEMICAL DIVISION

Woodward-Clyde Consultants
Consulting Engineers, Geologists
and Environmental Scientists
Baton Rouge, Louisiana

CEDAR CHEMICAL CORPORATION
VICKSBURG, MISSISSIPPI

SCALE	NOTES	MADE BY	CHK	DATE	NO. 00	121 05
		CHECKED BY		DATE		828007C

BOPAL _____
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 TECHNICIAN _____
 APPROVED _____
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**SHOPLIFTING
STUNNING THE
(TAP)**

WATER

福

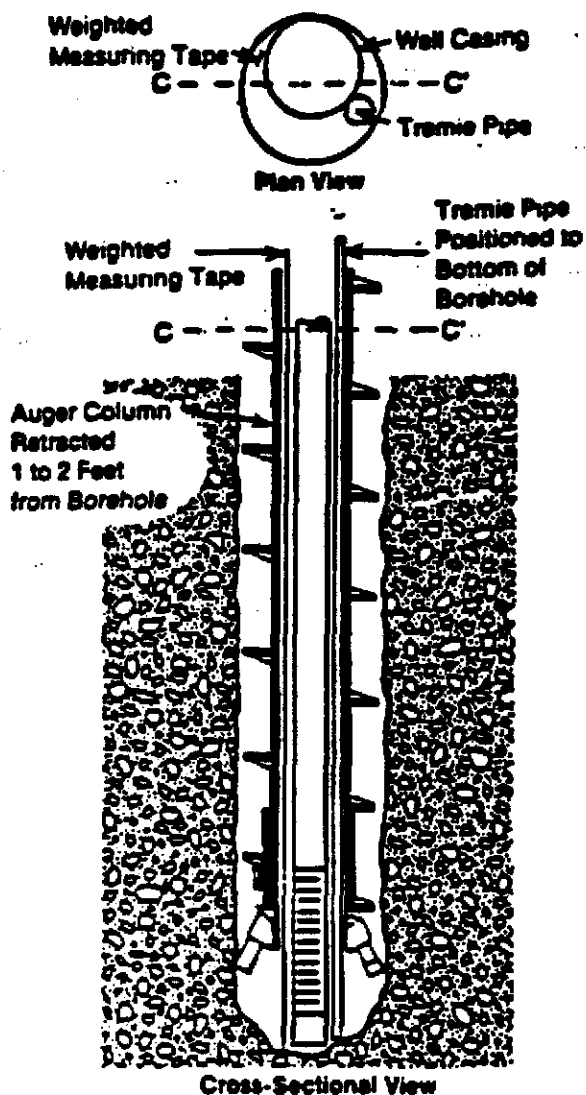
14

1

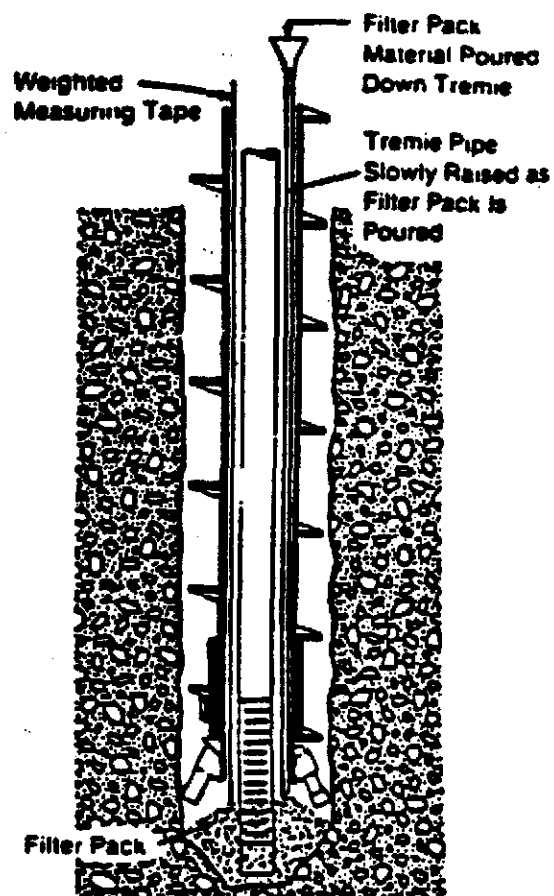
DESCRIPTION OF STUDIES

FIGURE 8

- WOODWARD-CLYDE CONSULTANTS



a. Weighted Measuring Tape and Tremie Pipe in Retracted Auger Column



b. Filter Pack Poured Through Bottom-Discharge Tremie Pipe

Tremie method of filter pack emplacement with a hollow-stem auger.

RFI WORKPLAN

Woodward-Clyde Consultants
Consulting Engineers, Geologists
and Environmental Scientists
Baton Rouge, Louisiana



**FILTER PACK
PLACEMENT THROUGH
A HOLLOW STEM AUGER**

FILE NO.

FIG. NO.

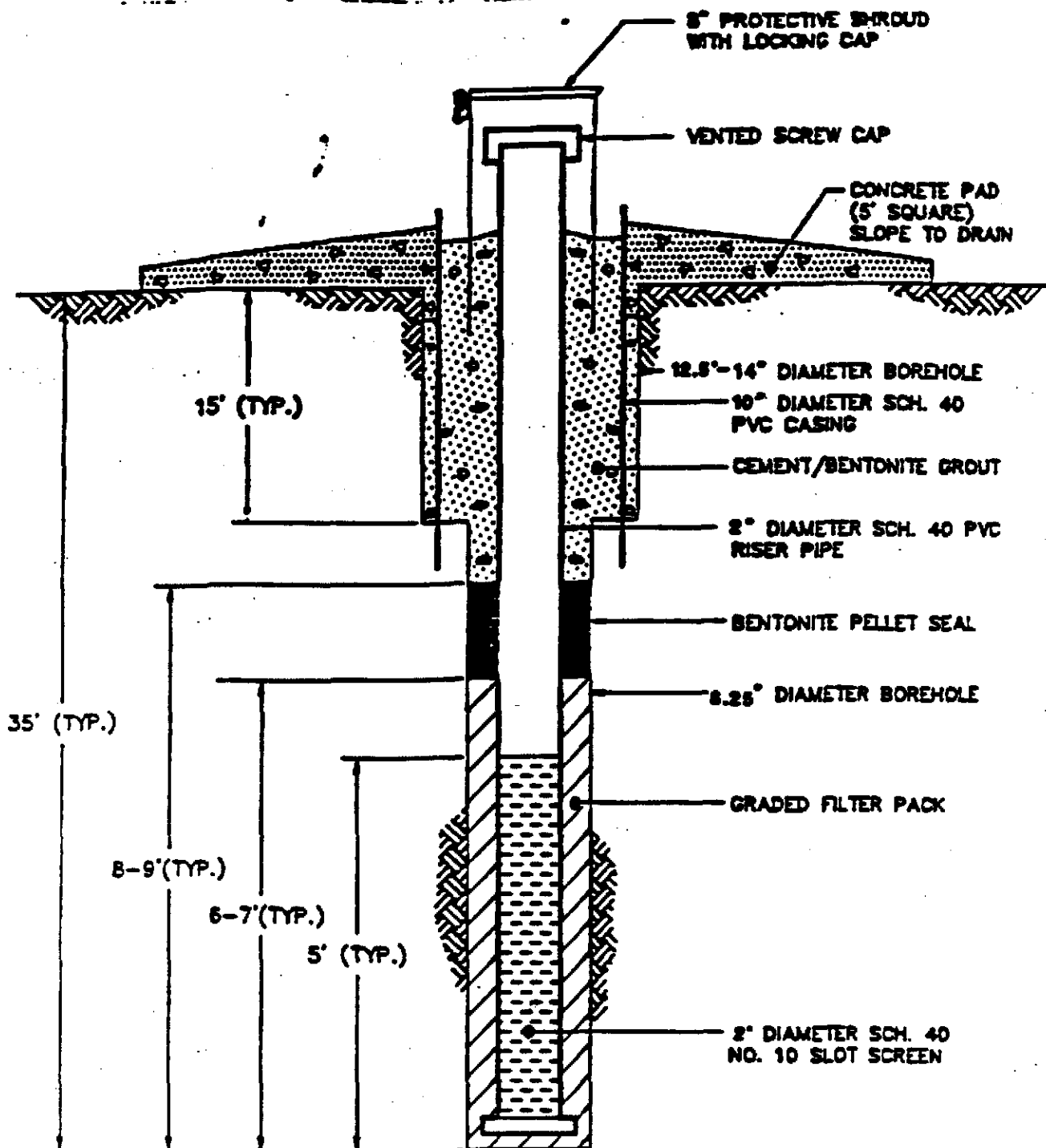
8

SCALE:
NONE

DRAW. BY
C-11 E-12/16

DATE

DATE 4/19/90



NOTE: IF WELL WIZARD SAMPLER IS INSTALLED,
TOP CAP WILL BE OF TYPE MANUFACTURED
BY QED INC. OR SIMILAR AND WELL WIZARD
PUMP INLET WILL BE POSITIONED
AT MIDDLE OF SCREEN

Woodward-Clyde Consultants
Consulting Engineers, Geologists
and Environmental Scientists
Baton Rouge, Louisiana



TYPICAL MONITOR WELL
CONSTRUCTION
DIAGRAM

FILE NO.

FIG. NO.

7

RFI WORKPLAN

SCALE:
NONE

DRAWN BY
CHKD BY JLM

DATE
DATE 4/14/90



MONITOR WELL INSTALLATION REPORT

PROJECT _____ PAGE _____ OF _____
 LOCATION _____ WELL NO. _____
 DATE COMPLETED _____ ORIGINAL DEPTH _____ AQUIFER _____
 INSPECTED BY _____ DATE _____
 CHECKED BY _____ DATE _____ DEPTH INTERVAL _____

GENERALIZED STRATIGRAPHY AND WATER LEVEL

ELEVATION OF TOP OF SURFACE CASING/
 RISER PIPE _____
 HEIGHT OF TOP OF SURFACE CASING/RISER
 PIPE ABOVE GROUND SURFACE _____
 DEPTH OF SURFACE SEAL BELOW
 GROUND SURFACE _____
 TYPE OF SURFACE SEAL: _____

 I.D. OF SURFACE CASING
 TYPE OF SURFACE CASING _____

 DEPTH OF SURFACE CASING BELOW GROUND _____
 I.D. OF RISER PIPE
 TYPE OF RISER PIPE: _____

 DIAMETER OF BOREHOLE _____
 DEPTH OF BOREHOLE _____
 TYPE OF BACKFILL: _____
 ELEV./DEPTH TOP TO SEAL _____
 TYPE OF SEAL: _____
 ELE./DEPTH BOTTOM OF SEAL _____
 TYPE OF SAND PACK _____
 DEPTH OF TOP OF SAND PACK _____
 ELEV./DEPTH TOP OF SCREENED SECTION _____
 TYPE OF SCREENED SECTION: _____
 DESCRIBE OPENINGS _____
 I.D. OF SCREENED SECTION _____
 ELEV./DEPTH BOTTOM OF SCREENED SECTION _____
 LENGTH OF BLANK SECTION _____
 ELEV./DEPTH BOTTOM OF PLUGGED
 BLANK SECTION _____
 ELEV./DEPTH BOTTOM OF SAND COLUMN _____
 TYPE OF BACKFILL BELOW OBSERVATION
 PIPE _____
 ELEV./DEPTH OF HOLE _____

Project: _____

File: _____

Made by: _____ Date: _____

Well Number: _____

Checked by: _____ Date: _____

GENERAL CONDITIONS:

Depth (ft. TOC/bottom): _____

Stick-up (ft. TOC/pad): _____

WCC Representatives: _____

PURGING DATA:

Purging (2 min. cycles)			Pressures (psi)		Water Level (ft. TOC)	
Date	Start	Stop	Tank	Working	Before	After

METHODS: _____

PUMPING DATA:

Pumping			Pressures		Water Level		Production (gpm)	Quantity (gallons)	Conditions
Date	Start	Stop	Tank	Working	Before	After			

STABILIZATION DATA:

Time																	
Temperature																	
Conductivity																	
pH																	

RECOVERY DATA:

Time (min)	2	5	7	10	15	20	25	30	40	50	60	90	120	240	24hr	Time
Level (ft.)																

REMARKS:

GROUND WATER COLLECTION REPORT

PROJECT NUMBER AND NAME _____ LOCATION _____
COLLECTOR/OPERATOR _____ WELL NO. _____
TYPE OF SAMPLE _____ () GRAB () COMPOSITE () OTHER _____
METHOD OF SAMPLING IF OTHER THAN MONITOR WELL _____ SHUTTLE NO. _____

MONITOR WELL INFORMATION

EVACUATION: DATE/TIME _____ METHOD OF EVACUATION _____
INITIAL DEPTH TO WATER LEVEL _____ TOP OF CASING TO BOTTOM _____
GALLONS PER WELL VOLUME _____ TOTAL GALLONS EVACUATED _____
FINAL DEPTH TO WATER _____ ELEVATION TOP OF CASING _____
SAMPLING: DATE/TIME _____ METHOD OF SAMPLING _____
DEPTH TO WATER LEVEL _____

SAMPLE DATA

FIELD REPLICATE #1	TEMP. _____	pH _____	CONDUCTIVITY _____
FIELD REPLICATE #2	TEMP. _____	pH _____	CONDUCTIVITY _____
FIELD REPLICATE #3	TEMP. _____	pH _____	CONDUCTIVITY _____
FIELD REPLICATE #4	TEMP. _____	pH _____	CONDUCTIVITY _____

GENERAL INFORMATION

WEATHER CONDITIONS AT TIME OF SAMPLING _____
SAMPLING CHARACTERISTICS _____
CONTAINERS AND PRESERVATIVES _____

RECOMMENDATIONS _____

SAMPLING PERSONNEL _____

TIME _____ TO _____

DATE _____

(SIGNED)

LOCK OR SERIAL NUMBER _____ REPLACEMENT SERIAL NUMBER _____

CHAIN - OF - CUSTODY RECORD

[illegible]

SAMPLE COLLECTION:

PROJECT NO. AND NAME _____
LOCATION OF SAMPLE: _____
COLLECTOR'S NAME _____ TELEPHONE: () _____
COMPANY NAME: _____
ADDRESS: _____
WITNESS: _____ COMPANY NAME: _____

FIELD INFORMATION:

TYPES OF SAMPLES: LIQUID GAS SLUDGE SOIL OTHER(SPECIFY) _____
 FIELD NOTES: _____
 TRANSPORTER: _____ AIRBILL/INVOICE: _____ DESTINATION: _____

SAMPLE TRANSFER (Original must be retained with sample at all times)

		RELINQUISHED BY	DATE/TIME	RECEIVED BY	DATE/TIME
1	NAME:				
	COMPANY:				
2	NAME:				
	COMPANY:				
3	NAME:				
	COMPANY:				

TERMINATION OF CHAIN-OF-CUSTODY:

AUTHORIZED BY: _____ DATE: _____ TIME: _____
 COMPANY NAME: _____
 SAMPLE DISPOSITION: STORAGE _____ DISPOSAL _____ OTHER _____

SAMPLE ANALYSIS REQUEST FORM

PROJECT NAME _____
PROJECT NUMBER _____
PROJECT CONTACT _____
REPORTING ADDRESS _____

LOCATION _____
SAMPLING TEAM _____
PURCHASE ORDER NO. _____
PROJECT CONTACT PHONE NO. _____
REQUESTED TURNAROUND _____
LABORATORY DESTINATION _____

[illegible]

SPECIAL HANDLING (e.g. ICE, DRYROOM, FLAMMABLE, ETC.).

DATE SHIPPED: _____ PACKAGED BY: _____
SHIPPING METHOD: _____ AIRBILL/INVOICE: _____

FIGURE 12

PTDIAJOUWU

CORRECTIVE ACTION REPORT

DATE _____

PROJECT NUMBER AND NAME _____

LOCATION _____

INITIATOR'S NAME AND TITLE _____

NONCONFORMANCE _____

REPORTED TO _____

CORRECTIVE ACTION _____

IMPLEMENTED BY _____

REVIEWED BY _____

cc: PROJECT MANAGER _____

SITE MANAGER _____

QA OFFICER _____

APPENDIX E
DATA MANAGEMENT PLAN

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DATA MANAGEMENT PLAN

1.1 INTRODUCTION

During the North Pond RCRA Facility Investigation (RFI), various types of data will be generated. At a minimum, data gathered will consist of field data sheets, field log books, boring logs, chemical data from analysis of soil and groundwater, field parameter measurements, maps and drawings. This Data Management Plan describes procedures that will be used to physically manage project related information. The Data Management Plan addresses:

- Project organization and responsibilities
- Technical approach to data management
- Flow of data (tracking)
- Data validation and reduction
- Data presentation

PROJECT ORGANIZATION AND RESPONSIBILITIES

A description of primary project personnel and their responsibilities is presented below. Changes in procedures presented below will be documented.

2.1 AUTHORITY AND RESPONSIBILITIES

2.1.1 Project Manager

Richard D. Karkkainen, Woodward-Clyde Consultants (WCC), Vice President and Principal, will serve as Project Manager. The Project Manager will be the prime contact with Vicksburg Chemical Corporation (VCC) concerning all the work that is done by WCC. Project organization and management procedures will be established by the Project Manager, including reviews and approval of work scope, budget, schedules and reports. The Project Manager will also direct financial reporting and subcontractor recommendations for Cedar's approval.

2.1.2 Site Coordinator

Dr. Yong Goh will be designated for this project. The Site Coordinator's primary responsibility is to oversee all field phases of the activities under the direction of the Project Manager. Additionally, the Site Coordinator will manage onsite files and monitor quality assurance in the field.

2.1.3 Task Leaders

The task leader for data management validation and analytical services is Dr. Charles Westerman. He will be assisted by Anna Saucier.

2.2 PROJECT COMMUNICATIONS

2.2.1 Record Control

The control of records provides for the flow of information both internal and external to WCC.

Following receipt of information from external sources, completion of analyses, and issuance of reports or other transmittals; associated records shall be submitted to the WCC office central project files. This shall include any records generated for WCC by subcontractors. Records shall be legible and easily identifiable. In addition, field records and records transmitted between WCC and contractor offices shall be adequately protected from damage and loss during transfer (e.g., hand carrying or making copies prior to shipment).

Field records, laboratory data summaries, numerical calculations, reports and other data transmittals, copies of proposals, purchase orders, contracts, correspondence, memorandums, telephone records, photographs, and reference material shall be transferred to the project central file.

Records submitted to the project central file, with the exception of correspondence, should be bound, placed in folders or binders, or otherwise secured for filing.

2.2.2 Record Status

All individuals on the Project Staff shall be responsible for reporting obsolete or superseded project-related information to the Project Manager on a periodic basis. In turn, the Project Manager shall notify the Project, Laboratory Staff, and Quality Assurance personnel of the resulting status change in project documents, such as drawings and project procedures. Notification of personnel of status changes in quality assurance procedures shall be the responsibility of the Project Manager.

In general, outdated drawings and other documents shall be marked "void." Any copy of void documents maintained for the project files shall state the reasons for and date of voiding.

To denote that calculations, drawings, and other material which have not been formally checked are preliminary, they shall be marked "preliminary".

2.2.3 Record Retention

Information associated with the project shall be retained in the WCC office central project files.

These files will include the following:

- Project central file (project material except drawing originals, records related to laboratory analysis)
- Original drawing file
- Generic quality assurance file

Project records shall be received at the various storage areas by designated personnel. Designated personnel shall check that incoming records have proper identification for filing, are legible, and are in suitable condition for storage. Indexing and filing of records shall be performed only by the designated personnel.

For the project central file, the individual file folders shall be divided into appropriate categories based on content and numbered and filed sequentially within each category.

A numbered index for the project central file shall list the individual file folders and identify the records therein to facilitate locating the records. The index shall be kept in a separate folder at the front of the project file. If appropriate, information on project material not stored in the project central file should be included with the index.

For the original drawing and quality assurance files, all material shall be filed only by project number.

The record storage in the central files shall utilize facilities that provide a suitable environment to minimize deterioration or damage and that prevent loss. The facilities shall, where possible, have controlled access and shall provide protection from excess moisture and temperature extremes. Records shall be secured in binders, placed in folders or envelopes, or otherwise secured for storage in containers (e.g., steel file cabinets).

Storage systems shall provide for the prompt retrieval of information for reference or use outside the storage areas. For the project central file, sign out sheets shall be maintained so that a record of files removed is available.

2.2.4 Onsite Records

Appropriate requirements for the field control and retention of records generated as a result of site investigation, sampling, and testing shall be followed. A file, similar to the project central file, will be established and maintained by the Site Coordinator.

Upon completion of the field program or program phase, the onsite file will be transferred to, and integrated with, the WCC office central project files.

2.2.5 Change Control

It is imperative that the status of work items be up-to-date. A status system includes:

- Formal document and design drawing revision
- Nonconformance identification, documentation, and reporting
- Change documentation and approval

Change from original design documents, procedures, and specifications must be expected. Change does not imply a nonconformance to the work, but simply means that original plans must be altered because of information or events that occur during the work.

Change must be documented, evaluated, and reported as necessary. It is necessary to manage change so that the actual course of the project, not the original plan, can be demonstrated and justified. Changes must be documented so that the actual course of work is known and the effect of the change upon the course of work can be evaluated.

It is the responsibility of project personnel to appropriately record the change and to make the documentation available as appropriate to project or laboratory management. The effect of the change upon the project shall be evaluated by the project or laboratory management, quality assurance personnel, and/or subcontractor management.

Review and written approval for changes which affect the project activities should be provided by the Project Manager. Following the review and approval process, notification of the change should be made to appropriate personnel and affected documents revised as necessary to reflect the work as actually performed.

Project documents and design drawings (as discussed below) must be reviewed, approved, distributed, and revised as necessary. This control will provide approved, up-to-date information and drawings.

PRINCIPLES OF DATA MANAGEMENT

3.1 GENERAL PRINCIPLES

Three major approaches to database design are the Network, the Hierarchial and the Relational approaches. These three approaches have their respective strengths and weaknesses and in some applications, one approach is more suited than the others. Of the three methods, the relational approach is gaining momentum in the database market and is used in various applications. Because of its popularity, versatility, ease of use and the availability of many commercial relational database packages, WCC has chosen the relational approach for its design of the VCC database.

In the relational approach, the information is stored in tables and columns. A table is called a relation and columns are the attributes of the relation. A good relational design of a database management system minimizes data redundancy, maintains data consistency and ensures data integrity. Data redundancy refers to the storing of the same information in multiple tables. Redundancy can rarely be totally eliminated but can be reduced. Data consistency refers to maintaining redundant data in the same form at all locations in the system. That is, if data is changed at one location, the system should propagate similar changes in that data in other related tables. This action ensures the integrity of the data in the database.

3.2 OBJECTIVES OF THE SYSTEM

The data management, as defined herein for this project, refers to the actual management of the data, but also includes data validation. Quality Assurance/Quality Control (QA/QC) deals with data validation procedures. WCC has identified the following objectives for effectively managing the field data and the laboratory results data from the VCC site:

- Store and organize all field, analytical and other data.
- Track the samples for extraction and analysis holding time deadlines.
- Validate the analytical results.
- Make provisions for transmission of data to VCC.

TECHNICAL APPROACH

The above objectives are accomplished through a data management task leader and a data validation task leader.

4.1 DATA MANAGEMENT TEAM

The task leader is responsible for the following:

- Design and develop a system to store and organize all field and analytical data.
- Establish procedures to follow as the data arrives from the field and the laboratory.
- Interface with WCC's technical staff and provide the information they request.
- Produce tables for reports to VCC, regulatory agencies and other appropriate groups.
- Maintain and administer the system developed.

The need for an organized system which facilitates easy and instant access to the information desired, is obvious because of the volume of the data generated by this project. Without such a system, the process to organize the data in the desired manner will be very time consuming and labor intensive. Establishment of proper procedures will streamline the operation of data collection, organization and presentation. Once the system is established, maintenance and administration is essential for its continued success.

4.2 DATA VALIDATION TEAM

The task leader is responsible for the following:

- Review the QA/QC information for the samples.
- Validate the analytical results.
- Contact the laboratory, if inconsistencies exist.
- Interface with the data management team to insure the validity of analytical results in the data management system.
- Maintain records of the validation of analytical data.

Validation of analytical results is essential to determine the quality of the analytical data received from the laboratories and assure quality data in the system. The Data Collection Quality Assurance Plan details the method of validation for organic and inorganic analyses.

5.1 ENVIRONMENTAL DATA SYSTEM

Woodward-Clyde has recently completed Version 1.1 of its environmental database EDGE (Environmental Data Grab and Export).

EDGE is a Windows-based front end to an Oracle database. EDGE contains standardized tables for the storage of geological, geotechnical, hydrogeological, hydrological, soil, chemical and hazardous waste data. Seismic, air quality and any other type of data relating to the environment can also be stored. EDGE has point-and-click user friendliness for form design, data entry, query and export of data.

5.1.1 Sample General Information

This module tracks sample information such as sample number, sample location, date collected, time collected, number of containers used, the type of analysis requested, the person collecting, and so forth. This module has the options for adding, editing, browsing, querying, and printing information.

5.1.2 Sample Analysis Information

This module tracks analytical results received from the laboratories. It stores the date extracted, date analyzed, concentration and all pertinent information for each sample. It has the same options as before for adding, editing, deleting, browsing, querying, and printing analytical results information.

5.1.3 Sample Tracking Information

This module provides the sample extraction and analysis holding time deadlines for each sample. Reports of extraction and analysis holding time deadlines can be printed for any sample. This kind of reporting will help with data validation.

5.1.4 Site, Well Information

This module tracks site, monitoring well, and other support information required for the project. The system provides add, edit, delete, browse, query, and print options for each entity for this module.

5.1.5 Export - Import

This module provides the mechanism to both export and import data from laboratories and other consultants on the project. The import facility is laboratory specific. The export facility can provide the data requested by the analytical laboratory and others.

The following are procedures to be followed to effectively manage project data:

- All field and analytical data should be sent to Anna Saucier.
- The field personnel will send a copy of the Chain-of-Custody (COC) form to the Baton Rouge Office via facsimile after sending a batch of samples to the laboratory for analysis.
- When the preliminary analytical results arrive, the results are verified with COC, assuring that samples are identified with correct sample numbers.
- The task leader for data management, validation and analytical services, informs the project manager so if any discrepancies are found in the data, so that discrepancies can be rectified.
- When the final analytical results arrive, the data package is routed for validation.

5.2 DATA REDUCTION AND VALIDATION

Data reduction, validation, and reporting will follow guidelines as presented in this section. The only data that will be reported by WCC will be data that meet the record keeping, quality assurance/quality control criteria, and reporting formats as defined in the Data Collection Quality Assurance Plan.

The following sections describe the procedures to be used in data reduction, validation and reporting of analytical data.

5.2.1 Sampling Data

The intention of these sampling data management procedures is to maintain accurate records of all samples taken and to follow the status of the sample location and analytical results, while minimizing the duplication of record keeping activities and the possibilities for errors.

The tabulation and flow of all data management information can be broken down into the following activities:

- Assignment of sample numbers, sample label preparation, and initial permanent record keeping,
- Preparation and labeling of all sample bottles,
- Sampling and in-the-field record keeping,
- Sample receiving and preparation for shipping, and
- Complete sample record book.

5.2.1.1 Sampling Record Keeping

Prior to collecting a group of samples, the Site Coordinator or designee will assign a sample number and a description to all samples to be collected within the group. Sample numbers will be assigned to all divisions of the original sample, all of which have the same identification number with letters denoting subset containers. The sample number and corresponding description will be entered into a permanent record book. The information in the record book will then be written onto the appropriate sample label. When written, the sample labels will be given to the individual responsible for preparing the sample bottles.

The typed/printed labels for a group of sequentially numbered samples and a copy of the data book pages that include these numbers will be given to the sample bottle preparer and/or the sampler. This individual is responsible for applying all labels on

the appropriate types of bottles. The sample preparer may also be the person who will be doing the sampling. A copy of the data book pages that include information about the samples will also be given to the person doing the sampling in order to provide a list of samples to check off during the sampling activity.

The individual(s) doing the sampling is (are) responsible for verifying that each sample is put in the appropriate sample bottle. At the time of sampling this person must fill in the time sampled, the date sampled, and sign and complete the sample's label. By the end of the sampling day, the sampler must return all samples to the geologist or engineer who will oversee preparation of the samples for shipment (i.e., review chain-of-custody forms, inspect packaging, etc.

The person responsible for shipping the full sample bottles will compare the sample bottles with the appropriate sample data book pages. This person will then prepare the samples for shipping. Chain-of-custody forms must be completed for each sample; the originals must be sent with the samples, and copies will be sent to the sample coordinator to include in the appropriate project files.

5.2.1.2 Sample Data Management

When the samples are ready to be sent to the laboratory, the Site Coordinator will examine the samples and note their condition. Information including the date sampled, time sampled, and method of preservation, for each sample will be entered in the sample record book.

At the time the samples are shipped, the sample coordinator will have a copy of the pages in the sample record book that include information on the sample numbers and the corresponding information on the date sampled, time sampled, and the date shipped.

5.2.2 Analytical Data

5.2.2.1 Data Flow

The laboratory will be responsible for reviewing all sample analyses according to their internal QA/QC procedures. Data validation will be completed by the laboratory prior to the delivery of the data package. Completed data packages will be available for review by the project data validation coordinator and the project QA officer who will also evaluate the laboratory's checks. Any problems will be resolved and all data will be validated before the data are reported. Following satisfactory completion of all QA/QC checks by the laboratory and the project data validation coordinator, the data will be available for external reporting.

5.2.2.2 Data Management

A data validation report will be provided in a timely manner following the completion of the laboratory analytical report. Only data that has been validated are to be released. Data that has been validated will be logged into a data base in which validated results are stored.

5.2.2.3 Data Validation

Data Validation, according to Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (QAMS-0050/80, Office of Monitoring System and Quality Assurance and Office of Research and Development, U. S. Environmental Protection Agency, Washington, D. C. 20460, December 29, 1980), is "a systematic process for reviewing a body of data against a set of criteria to provide assurance that data are suitable for their intended use", and entails editing, screening, checking, auditing, verification, certification, and review.

The purpose of data validation is to determine if the data conform to specifications and are suitable for the intended project usage. Therefore, all data will be subjected to screening in terms of conformance to project specifications and suitability for use. After completing a sampling program, the field data package (calibration records, chain-of-

custody, field logs, etc.) will be reviewed for completeness and accuracy. Data validation of analytical data will be completed before any of the results are released. The validation process described below will be done separately from the laboratory performing internal laboratory data validation.

The following is a brief description of the methods that will be used during validation of the CLP laboratory data. These data will be reported in a summary data package and evaluated for conformance to the analytical limits set forth in Functional Guidelines for Evaluating Organic Analyses (Hazardous Site Evaluation Division, U. S. Environmental Protection Agency, February, 1988) and Functional Guidelines for Evaluating Inorganic Analyses (Hazardous Site Evaluation Division, U. S. Environmental Protection Agency, July, 1988). These checks will be performed on all samples analyzed, and the results will be summarized in a report for each lot of reported sample data. Qualified data will be reported as such and the appropriate qualifiers will be used for reporting. Non-CLP data and CLP data reported without the CLP summary data packages will be reviewed with respect to holding times, initial and continuing calibrations, method blanks, laboratory control samples, samples, matrix spikes and matrix spike duplicates or duplicates.

If problems occur which would reject data, the following procedures should detect these problems and the problem data will not be reported. However, rejected data will be addressed in the validation report to evaluate completeness goals.

1. Compile a list of all investigative samples.
2. Compile a list of all QC samples, including but not limited to:
 - Field blanks
 - Trip blanks
 - Laboratory blanks
 - Laboratory duplicates
 - Performance samples
 - Matrix spikes
 - Matrix spike duplicates

- Laboratory control spikes
 - Laboratory control spike duplicate
3. Review chain-of-custody documents for completeness and correctness.
 4. Review laboratory analytical procedures and instrument performance criteria.
 - Sample media identification
 - Sample location and descriptions
 - Proper concentration units
 - Proper significant figures
 5. This data summary will be reviewed for potential data quality problems including:
 - Unexpected results
 - Common laboratory contaminants
 - Unusual spacial concentration/identification relationships
 - Samples in which dilution was necessary
 - Samples which may have exhibited "carry over"
 6. A sample summary will be prepared to assess precision, accuracy, and completeness of the analytical data.
 7. Laboratory records and data package requirements will be checked to assess completeness of the data package.

Laboratory performance results will be documented from the validation procedures or from precision or accuracy evaluations. The validation personnel will provide a means to notify the laboratory and initiate the appropriate corrective actions.

Despite all efforts to achieve the objectives of the laboratory QA/QC plan, the potential for error exists in laboratory chemical analyses and in the data reporting process. Every reasonable effort will be made to compare and double-check data reported from the

laboratory, data entered into the data management system and data subsequently reported in accordance with the procedures described herein.

All analytical results are to be classified as quantified, qualified or rejected through data validation activities. Quantified data are to be used in laboratory reports at the numerical value identified. Qualified data are to be used as an estimate and are not to be used as a quantitative measurement. Rejected data are not to be included in the analytical report. No further use for design or other activities is to be made on the basis of rejected data.

5.3 OTHER DATA (CALCULATION, LOGS, COMPUTER PROGRAMS, DRAWINGS) REDUCTION AND VALIDATION

During activities, calculations, logs, drawings, and computer programs may be generated as part of some of the tasks (site characterization, risk assessment, etc.) in the form of potentiometric interpretations, calculations for cancer risk, quantity calculations of contaminants, etc. In order to maintain consistency in the development of the data, the following verification procedures are presented.

Numerical analysis, risk assessment, and environmental modeling, if performed, will be subjected to controls. Any changes to final analysis, assessments, and modeling will be subject to the same level of control used for the original task.

Analysis, assessment, and modeling activities shall be performed in a planned and controlled manner. Performance responsibility rests with the Project Manager. Prior to initiating the activities, the Project Manager shall discuss the scope of the work, contractual and regulatory requirements, and applicable quality assurance/quality control procedures with assigned personnel.

5.3.1 Procedures

To provide evidence of satisfactory work performance, analyses, assessments, modeling, and their results shall be completely documented. Documentation may include calculations, computer programs, logs, drawings, and tables.

Calculations

Calculations shall be legible and in a form suitable for reproduction, filing, and retrieval. Documentation shall be sufficient to permit a technically qualified individual to review and understand the calculations and verify the results.

Calculations shall be performed on standard WCC calculation paper whenever possible. All calculations will provide the originator's name and date of work, the checker's name and date, calculation subject, project number, and page number. All of this information shall be completed for each page. For extra pages, such as large graphs, this information shall also be included.

Calculations should, as appropriate, include a statement of calculation intent, description of methodology used, assumptions and their justification, input data and equation references, numerical calculations including units, and results. Input data may include:

- Regulatory requirements.
- Performance and operational requirements under various conditions, Material, geological, environmental, and geotechnical requirements.
- Results of field and laboratory testing or calculations.
- Information obtained from external personnel or literature and site data surveys.

Computer printouts that become an integral part of the calculations shall be referenced in the calculations by run number or other unique means of identification.

At the end of calculations, the results should be summarized if this will provide clarity.

Computer Programs

Computer output shall be dated and clearly identified as to contents. Large sets of output shall be labeled with project name and number, program used, analysis title, and the user's name.

Logs, Drawings, and Tables

The results of analysis, assessment, and modeling activities may be presented in logs, drawing, and tables of various forms. The format of logs and tables shall be governed by the information to be presented. Drawings shall be uniquely identified by drawing or figure number and appropriate title. Standardized symbols and nationally accepted drafting standards shall be used. References to other drawings and sources of information shall be provided, as necessary.

Drawings shall be signed and dated by the draftsman performing the work and the project task leader or Project Manager who has checked the drawing.

Revisions shall be noted on the drawing original with a revision number and a brief note describing each revision. The note shall be signed and dated by the draftsman performing the work and the project task leader or Project Manager who has checked the revision.

Indication of final drawing and revision approval shall be through signing and dating the drawings by the project task leader or Project Manager.

5.3.2 Verification

Calculations, computer program input, logs, drawings, and tables shall be formally checked using the process outlined in the following paragraphs.

Calculations

Verification of calculations shall be performed by an individual(s) other than the persons who performed the original work, or specified the method or input parameters to used. The individual(s) selected shall have technical expertise in the calculation subject.

It is emphasized that a numerical check is not sufficient. The checker is responsible for every item on every sheet-including the completion of the title block and page numbers.

To properly check calculations:

- The originator supplies the designated checker with a machine copy of the calculations. Originals should not leave the originator's possession until they are ready for final checker signing,
- The checker marks the calculation copy with a highlighter for all items he approves,
- The checker marks the calculation copy with a highlighter for all items he approves,
- If the checker disagrees, for any reason, the checker crosses through the item with different colored markers and writes the recommended correction or comment above it,
- The checker initials and dates all pages of the checkprints,
- The checker returns the checkprints to the originator who, in turn, reviews all recommended changes. If a disagreement exists, the originator adds comments to the checkprints using a third color and then confers with the checker until all differences are resolved,
- The originator corrects, or "scrubs," the calculation originals so they agree with the checkprints. A one-to-one correspondence between the originals and checkprints must exist,
- The originator gives the originals the checkprints to the checker who compares them to verify agreed-to-corrections have been made, and
- When the checker is satisfied, he signs and dates the originals.

Computer Program Input

Computer input shall be formally checked using the process outlined above. A single exception to this process is that the checking may be performed on the input originals. The verification shall include a conceptual review of the program itself based on the problem being solved, a review of the computer model employed, a check that the program has been verified, and a formal check of the input data.

Drawings

Drawings shall be checked like calculations using different colored markers. Checkprints of the same drawing shall be marked CP1, CP2, etc., to show progression of the checking process.

If a drawing is revised, the entire checking process shall be repeated for the revised areas only. A new checkprint shall be prepared.

Logs and Tables

Final subsurface logs shall be verified by the responsible member of the Site Coordinator. The verification shall provide that changes from the original field representative's logs to the final log sheets are consistent with the results of other investigations. The final log sheets shall be checked in the same manner as all calculations or drawings, with the checker signing and dating all checkprints.

In addition, all final tables presenting information, data, or the results shall be checked using the process previously described. Checkprints of the same table shall be marked CL1, CL2, etc., to show progression of the checking process.

5.4 DATA PRESENTATION

AutoCAD, a computer aided design program is used for drawing maps and various figures. A base map will be used to produce the site map for field personnel and to produce maps of contaminant concentrations.

5.5 DATA MEASUREMENT ASSESSMENT PROCEDURES

This section summarizes QA/QC procedures for assessing the chemical data derived from the sampling and chemical analysis tasks. This same information is found in the Data Collection Quality Assurance Plan.

The data validation procedures will be used by the QA officer and the data validation coordinator for assessing duplicate and spike samples and checking blank samples that are submitted to the analytical laboratory from the field or generated internally by the laboratory. The purpose of implementing these procedures is to verify that the chemical data generated during the project are accurate, precise, complete, and representative of site conditions.

Detailed discussions of the procedures for data validation are presented in Section 5.2.2.3. The format for QC data assessment reporting is presented below.

5.5.1 Procedures for Assessing Data Accuracy, Precision, and Completeness

Chemical data derived from the project will be assessed for accuracy and precision for both the analytical laboratory and field sample collection programs. The primary goal of the program is to verify that the data reported during the project are representative of conditions in the local study area. To meet this goal, a combination of procedures and qualitative evaluations will be used to check the quality of the data. Sample recollection and analysis will be used only if the data are rejected and sample results are deemed to be critical to the determination of a project objective.

The QA/QC assessment program will evaluate the project's data based on the types of quality control samples described in the Data Collection Quality Assurance Plan. The procedures for evaluating both the project and laboratory QA/QC data are the same and are presented below for QA/QC spikes, blanks, and duplicate and/or replicate samples.

5.5.2 Blanks

The evaluation procedure for blanks is a qualitative review of the chemical analysis data reported by the laboratories. The procedure for assessing blank samples will be as follows:

- Tabulation of the data from the blank samples,
- Identification of any blank samples that have chemicals detected in the sample,
- If no chemicals are detected in the blank samples, the tables are ready for entry into the appropriate report,
- If any chemicals are found in blank samples, the compound(s) and concentration(s) will be reported and the field data for that period of time will be assessed for potential problems with data interpretation. Data may be removed from the data base on the basis of chemicals being detected in blank samples. Appropriate notations, however, will be made in the data base reports,
- Quality control records will be maintained for each source of water which is used. These records shall demonstrate over time the presence/absence and level of contaminants found.

5.5.3 Spikes

The procedure for assessing spike samples will be as follows:

Tabulate spike sample data and calculate the Spiked Sample Recovery (SSR) percent as shown below for each sample.

$$SSR (\%) = \frac{(T-X)}{A} \times 100$$

where: T = total concentration found in spiked sample
X - original concentration in sample prior to spiking
A - actual spike concentration added to sample

A comparison of the spiked sample calculated recoveries will be made to the percent recovery for each spiked analyte as specified within U.S. EPA CLP, as appropriate.

5.5.4 Duplicates

The procedure for assessing duplicate and replicate samples will be as follows:

Tabulate duplicate data and calculate the Relative Percent Difference (RPD) as shown below for each duplicate pair:

$$RPD (\%) = \frac{(X1 - X2)}{X} \times 100\%$$

where:

X1 = concentration for Sample 1 of duplicate

X2 = concentration for Sample 2 of duplicate

X = average of Samples 1 and 2

The calculated relative percent difference will be compared to the control limit values given in the EPA CLP, as appropriate for each of the spiked analytes to qualitatively evaluate the significance of the data. The evaluation will focus on historic variations in concentrations, whether problems arise for one particular compound or random compounds and whether the problem is limited to one sampling location, sample homogeneity, the amount of the spike, etc. If data quality problems arise, the analytical data will be annotated, and the laboratory will be notified for corrective action, as appropriate. Data will be reported only if approved by data validation coordinator or the QA officer. The laboratory and the data validation personnel must review the analytical data in a timely fashion for an effective data evaluation process.

The laboratory data verification and review process includes a review of the data file for completeness, the results, and includes a preliminary QA/QC review. The laboratory data package (or report) is reviewed to locate and check the following, where appropriate.

- Laboratory and field blanks for verification of frequency and that there are no contaminants in the associated blanks and, if present, assess their impact on interpretation of the data.
- Field and laboratory duplicates to determine if the data results match adequately and if the frequencies are acceptable.
- Spike recovery data to assure they are within quality acceptance limits and frequencies are acceptable.
- Calibration documentation to verify equipment performance is acceptable.
- Accuracy and precision of Laboratory Control Samples.
- Instrument tuning documentation to verify successful completion.
- Holding time evaluation.

5.5.5 Identification of Outliers

A reported concentration value that is much different from most other values in a data set for the same group is referred to as an "outlier." The reasons for outliers can include:

- Inconsistent sampling or analytical chemistry methodology
- Errors in transcription of data values or decimal points
- Actual but extreme concentration values
- Amended errors in analytical methodologies

The procedures described for data validation and review will identify any outliers that are due to the first two causes mentioned above. Any outlier not attributable to these two causes may be due to actual but extreme concentration values. The data point in question will then be compared to data from similar settings. For example, a reported high concentration of one compound in ground water from a well will be compared to previous data from the same well, if available, and/or compared to data from nearby wells. Also, other aspects of the reported data will be examined to determine if a high reported concentration of a single constituent occurs in other samples but cannot be duplicated in replicate or QC samples. Sample results designated as "outliers" may be resampled and analyzed if deemed to be necessary by WCC.

APPENDIX F

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

**VICKSBURG CHEMICAL CORPORATION
VICKSBURG, MISSISSIPPI**

October 1993

Woodward-Clyde Consultants



Consulting Engineers, Geologists, and Environmental Scientists
2822 O'Neal Lane, Baton Rouge, LA 70896

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1.0

HEALTH AND SAFETY PLAN

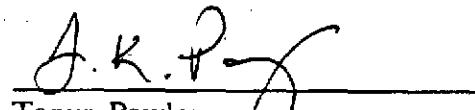
Client: Vickburg Chemical Corporation
Project: RFI Field Investigation, Groundwater
Assessment, and Interim Measures
Project Manager: Richard D. Karkkainen
Project Number: 92B007C
Date of Plan: Revised October 22, 1993
Estimated Dates of Work: North Pond, October 25, 1993 through
November 5, 1993, Additional Pending EPA
and MSDEQ
Expiration Date: Pending EPA and MSDEQ

1.1 HEALTH AND SAFETY PLAN APPROVALS




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10/22/93
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INTRODUCTION

This Health and Safety Plan establishes guidelines and requirements for the safety of field personnel during the conduct of the field activities associated with the referenced project. The specific activities addressed by this plan are defined in Section 3.0. All employees of Woodward-Clyde Consultants (WCC) involved in this project are required to abide by the provisions of this plan. They are required to read this plan and sign the attached Compliance Agreement.

The health and safety guidelines and requirements presented are based on a review of available information and an evaluation of potential hazards. This plan outlines the health and safety procedures and equipment required for activities at this site to minimize the potential for exposures of field personnel. This plan may be modified by the project manager, the corporate health and safety officer, and the Baton Rouge health and safety officer in response to additional information obtained regarding the potential hazards to field investigative personnel. This plan has been prepared for the exclusive use of WCC Personnel and WCC subcontractors. WCC liability is extended to WCC Personnel and WCC Subcontractors only.

2.1 KEY PERSONNEL

Project management will be handled out of the Baton Rouge Operating Unit of WCC. The following is a description of job responsibilities and authorities:

Project Manager: Richard D. Karkkainen

For this project, the Project Manager has the following responsibilities:

- To see that the project is performed in a manner consistent with the WCC Health and Safety Program.

- To have an approved Health and Safety Plan prepared and properly implemented for this project.
- To provide the Business Unit Health and Safety Officer with project information related to health and safety matters and development of the Health and Safety Plan.
- To implement the Health and Safety Plan.
- To insure compliance with the Health and Safety Plan by WCC and contractor personnel.
- To coordinate with the Business Unit Health and Safety Officer on health and safety matters.

The Project Manager has the authority to take the following actions:

- To determine matters relating to schedule, cost, and personnel assignments on hazardous waste management projects.
- To temporarily suspend field activities, if the health and safety of personnel are endangered, pending further consideration by the Business Unit Health and Safety Officer.
- To temporarily suspend an individual from field activities for infractions of Health and Safety Plan, pending further consideration by the Business Unit Health and Safety Officer.

Health and Safety Officer: Tanya Pawley

The Health and Safety Officer has the following responsibilities:

- To interface with the Project Manager as may be required in matters of health and safety.

- To approve a Health and Safety Plan for the project.
- To appoint or approve a Site Safety Officer to assist in implementing the Health and Safety Plan.
- To monitor compliance with the approved Health and Safety Plan.
- To assist the Project Manager in seeing that proper health and safety equipment is available for the project.
- To approve personnel to work on this site with regard to medical examinations and health and safety training.

The Health and Safety Officer has the authority to take the following actions:

- To suspend work or otherwise limit exposures to personnel, if a Health and Safety Plan appears to be unsuitable or inadequate.
- To direct personnel to change work practices, if they are deemed to be hazardous to health and safety of personnel.
- To remove personnel from the project, if their actions or condition endangers their health and safety or the health and safety of co-workers.

WCC Site Safety Officer: Yong Goh

The Site Safety Officer (SSO) has the following responsibilities:

- To direct health and safety activities on-site.
- To report safety-related incidents or accidents to the Project Manager and Business Unit Health and Safety Officer.

- To assist the Project Manager in all aspects of implementing the Health and Safety Plan.
- To maintain health and safety equipment on-site, as specified in Health and Safety Plan.
- To perform health and safety activities on-site, as specified in the Health and Safety Plan, and report results to the Project Manager and the Business Unit Health and Safety Officer.

The SSO has the authority to take the following actions:

- To temporarily suspend field activities, if the health and safety of personnel are endangered, pending further consideration by the Business Unit Health and Safety Officer.
- To temporarily suspend an individual from field activities for infractions of the Health and Safety Plan, pending further consideration by the Business Unit Health and Safety Officer.

WCC Corporate Health and Safety Officer: Charles Self

The WCC CHSO has the following responsibilities:

- Direct the implementation of the Health and Safety Program of the operating group and provide recommendations for improvement of the program.
- Coordinate health and safety activities of the operating units in the operating group.
- Determine need for project Health and Safety Plans.
- Review and approve Health and Safety Plans.

- Monitor implementation of Health and Safety Plans.
- Investigation reports of incidents or accidents and report accidents or incidents to the CHSA and EVPP.
- Assist CHSA with employee health and safety training in the operating group.
- Determine whether an accidental exposure or injury merits a change in the affected individual's work assignments and whether changes in work practices are required.
- Coordinate business units with regard to health and safety equipment needs.

The WCC CHSO has the authority to take the following actions:

- Approve or disapprove Health and Safety Plans.
- Direct operating unit HSO to prepare project Health and Safety Plans.
- Access project files.
- Direct changes in personnel work practices to improve health and safety of employees involved in hazardous waste management projects.
- Remove individuals from projects, if their conduct jeopardized their health and safety or that of co-workers.
- Suspend work on any project that jeopardizes the health and safety of personnel involved.

2.2 SITE LOCATION

Vicksburg Chemical Corporation (VCC) is located less than a mile south of Interstate 20 bordering the City of Vicksburg, Mississippi. To the north and west of the site is light residential properties. To the East of the site is light industrial properties including the Vicksburg water treatment facility and an asphalt mixing and gravel drying operation. To the South of the site is light residential to rural properties.

2.3 SITE DESCRIPTION

VCC is located off Highway 61 on Rifle Range Road. The facility is comprised of a North Plant and a South Plant and occupies approximately 640 acres. Currently, the only active areas of the plant include the nitric acid and potassium nitrate plants. All other portion of the plant are no longer in operation. Resources such as a potable water supply, electricity, and telephone service are available at the plant office located at the facility entrance on Rifle Range Road. Chemical on-site relative to the aforementioned active plants include anhydrous ammonia, nitric acid, potassium chloride, chlorine, and occasional nitrogen tetroxide, and nitrogen dioxide. Chemical on-site related to past production activities include atrazine, dinoseb, methyl parathion, monosodium methane arsenate (MSMA), and toxaphene. Other chemicals that have been detected on-site include carbon tetrachloride, chloroform, 1,1-dichloroethylene, ethylbenzene, methylene chloride, toluene, and xylene.

The work sites concerning this plan are associated with the South and North Plants (Figure 1) and include several Solid Waste Management Units (SWMUs) and Other Areas of Concern (OACs).

2.4 SITE HISTORY

In the past, VCC produced various types of pesticides and herbicides such as dinoseb, toxaphene, atrazine, and monosodium methane arsenate. All of these chemicals have been detected in the soil and water by VCC and the state of Mississippi. Concentrations range from less than extractable products on hazardous wastes to an average of about 5 part per million (ppm). Chlorinated solvents have been detected in

sludge sediments in the ppm range for carbon tetrachloride, methylene chloride, chloroform, and 1,1,-dichloroethylene. The source of the chlorinated solvents is unknown as well as the source of xylene toluene, and ethylbenzene, which have been detected in the range of 2-15 ppm.

PURPOSE AND SCOPE OF PROPOSED WORK

WCC will perform work as required in a Consent Decree effective April 17, 1992. This Consent Decree requires Interim Measures activities, a Groundwater Assessment Program, and a RCRA Facility Investigation be conducted at the facility. These three workplans require geophysical borings, monitor well sampling and installation, subsurface soil sampling, and surface soil sampling. Some construction in conjunction with sump closure may be included in the Interim Measures activities.

HAZARD ASSESSMENT

The following hazards have been identified and will be protected against:

- Heat stress.
- Biological hazardous.
- Physical hazards.
- Skin contact with organic contaminants.

4.1 BIOLOGICAL HAZARDS

If clearing has not been conducted or if biological hazards develop during work activities, practical guidelines for prevention of exposure to pests should be implemented.

4.2 HEAT STRESS HAZARDS

If heat stress becomes a concern, the heat stress casualty prevention plan, presented in Appendix A shall be implemented.

4.3 PHYSICAL HAZARDS

Personnel should be cognizant of the fact that when protective equipment such as respirators, gloves, and protective clothing are worn, visibility and manual dexterity are impaired. In addition, personnel should be alert to physical hazards such as slipping/tripping/falling potentially associated with dismantled process equipment and piping remnants/ladders/stairways in various stages of disrepair, and uneven ground surface due to foundation fragments distributed throughout the site. Drilling personnel should abide by standard safety guidelines applicable to drilling operation presented in Appendix B.

4.4 CHEMICAL HAZARDS

Due to past production activities at the facility, pesticides, herbicides, chlorinated solvents, and volatile organic solvents have been detected on-site during site characterization efforts conducted by VCC and the state of Mississippi. The constituents detected included dinoseb, toxaphene, atrazine, carbon tetrachloride, methylene chloride, chloroform, 1,1-dichloroethylene, xylene, toluene, and ethylbenzene at concentration report in the parts per million range. Of the constituents detected on-site, carbon tetrachloride, methylene chloride, and chloroform are classified by OSHA and/or ACGIH as known or suspected human carcinogens.

The constituents detected on-site are present in low concentrations. However, exposure to these chemicals may potentially occur through inhalation, ingestion, and/or direct contact. Chemical exposure via multiple exposure pathways is cumulative, therefore it is important to recognize potential exposure situations and to take precautions to minimize exposure to chemical hazards by all routes.

The following potential exposure routes and associated health hazards have been identified:

Inhalation: Chemical hazards associated with inhalation exposures may include irritation of the mucous membranes and respiratory tract or with more severe exposures, may include systemic effects. Table 1 presents recommended exposure limits for potential airborne constituents.

Ingestion: Ingestion of chemical will be controlled on-site by prohibiting eating, smoking, or drinking in the Exclusion Zone and by requiring all field personnel to conduct decontamination procedures prior to leaving the Exclusion Zone.

Direct Contact: Skin and eye contact with chemical hazards may potentially result in irritation, rashes, or burns. If a person should exhibit symptoms of eye or skin irritation, he/she should report to the SSO for immediate medical attention.

Potential hazards may be minimized by utilizing appropriate personal equipment designed to protect the body against contact with known or anticipated chemical hazards. Personal protective equipment is classified by the EPA by the level of protection afforded and is divided into four categories designated as Level A, B, C, and D with Level A providing the most extensive level of protection.

The levels of protection required for the field activities specified by the work scope are presented in Section 5.1

Chemical information sheets for each constituent known to be present at the site are presented in Appendix C. These sheets provide important information concerning physical/chemical properties, chemical/reactive hazards, exposure potentials, health hazards and symptoms of exposures, and appropriate treatment following exposure.

Table 1
Exposure Limits for Potential Airborne Contaminants

Constituent	ACGIH TWA	OSHA PEL-TWA	STEL	IDLH
+ Toxaphene	0.5 mg/m ³	0.5 mg/m ³	1 mg/m ³	200 mg/m ³
Atrazine	5 mg/m ³	5 mg/m ³	--	--
+ Carbon Tetrachloride	5 ppm	2 ppm	--	Ca
Methylene Chloride	50 ppm	500 ppm	--	Ca
Chloroform	10 ppm	2 ppm	--	Ca
Xylene	100 ppm	100 ppm	150 ppm	1000 ppm
Toluene	100 ppm	100 ppm	150 ppm	2000 ppm
Ethylbenzene	100 ppm	100 ppm	125 ppm	2000 ppm
Lime Kiln Dust	10 mg/m ³	10 mg/m ³	--	--
Ammonia	25 ppm	50 ppm	35 ppm	500 ppm

- + Potential Skin Irritant
 Ca Potential Human Carcinogen (Cancer Causing);
 -- No IDLH level established.

GENERAL HEALTH AND SAFETY REQUIREMENTS

5.1 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) required to prevent contact with known or anticipated chemical hazards has been divided into four categories by the USEPA, Levels A, B, C and D, according to the degree of protection afforded. The following personnel protective equipment will be provided to personnel involved in site characterization work at the site.

Mobilization - Level D Protection

- Boots, steel toe and shank
- Hard hat
- safety glasses with side shields

Modified Level D Protection

- Coveralls, chemical resistant; tyvek (polycoated tyvek if splash hazard exists)
- Gloves (outer), chemical resistant, Polyvinyl Alcohol (PVAL)
- Gloves (inner), chemical-resistant, latex
- Boots, chemical-resistant (or bootie covers), steel toe and shank
- Safety glasses with side shields
- Hard hat (with faceshield if splash hazard exists)

Modified Level C Protection

- To include Modified Level D; PPE mentioned above
- Full-face air purifying respirators with organic vapor/pesticide/HEPA combination filter cartridges.

Tyvek coveralls will be discarded after each use or when they become worn or punctured. Suit materials are resistant to all known or anticipated chemicals at the site. If the disposable protective suits appear to be deteriorating under chemical action, the Site Safety Officer should be notified.

In addition to the personal protective equipment listed above, general safety equipment available for use will include a first aid kit, portable eye wash and fire extinguisher.

5.2 WORK ZONES

During activities conducted in Modified Level D PPE, management of this project shall be conducted in such a manner which will restrict access to the job site by unauthorized personnel. If Level D action levels established in Table 2 are exceeded resulting in an upgrade to Level C PPE, work zones as described in the following paragraphs shall be implemented.

To minimize the movement of contaminants from the site to uncontaminated areas, three work zones will be set up during activities conducted under Level C PPE. The three work zones will include the following:

- | | |
|---------|------------------------------|
| Zone 1: | Exclusion Zone |
| Zone 2: | Contamination Reduction Zone |
| Zone 3: | Support Zone |

The exclusion zone is the zone where contamination does or could occur. Observations by the site safety officer will determine the extent of the zones. All persons entering this zone must wear at a minimum the level of protection set forth in Section 5.1 (Level C PPE).

Between the exclusion zone and support zone is the personnel contamination reduction zone (CRZ) which provides a transition zone between the contaminated and clean areas of the site. This zone will be located directly outside of the exclusion zone and will be defined as 10-foot zone directly outside the exclusion zone.

The support zone will be an uncontaminated area from which operations will be directed. It is essential that contamination from the site be kept out of this area. Included in this area will be a storage area for decontaminated clothing, additional personal protective equipment, etc.

One additional work zone will be set up for decontaminating equipment.

5.3 DECONTAMINATION PROCEDURES

VCC will have a minimum of one personnel decontamination station, strategically located or in the contamination reduction zone (CRZ) if applicable. The decontamination station will have at least the following items:

- An adequate-sized plastic sheet for flooring
- Boot wash equipment
 - Water/alconox solution container
 - Rinse water container
 - Long-handled plastic brush
- Waste container (disposable PPE, tape, etc.)
- Hand wash equipment
 - Water/alconox solution container
 - Rinse water container
 - Paper towels

5.3.1 Equipment Decontamination

Decontamination of sample collection equipment will be accomplished by the following procedure:

- Washing in a detergent solution (Alconox)
- Triple rinsing with clean deionized water
- Rinsing with methanol
- Triple rinsing with clean deionized water

Decontamination of equipment shall be conducted in Modified Level D PPE as listed in Section 5.1. While utilizing methanol for decontaminating equipment, personnel shall position themselves upwind of decontamination operations to minimize inhalation exposures to methanol vapors. If this is not feasible, respiratory protection as listed under level C PPE in Section 5.1 shall be worn during methanol use.

5.3.2 Personnel Decontamination

Decontamination of personnel will be performed at a designated location at the perimeter of the work area. Decontamination will consist primarily of soap and water washings and water rinse of exterior protective gear to remove contaminants, followed by doffing of the gear.

Coveralls should be removed by turning the clothing inside out. A general sequence of doffing procedures is outlined below. The extent of washing required, or modifications to the sequence, may be specified as appropriate.

Personnel will be decontaminated by the following procedure:

- Wash and rinse outer protective coverall
- Wash work gloves and boots
- Remove outer protective clothing
- Rinse respirator if worn
- Wash hands and face

Contaminated disposable PPE and all decontamination fluids shall be containerized on-site for subsequent disposal by the direction of VCC.

5.4 MEDICAL EXAMINATION

Before commencing any of the field or laboratory activities defined in Section 3.0, all WCC personnel and all WCC subcontractors must take an annual WCC-approved medical examination as part of WCC's medical surveillance program.

5.5 SAFETY TRAINING DOCUMENTATION

Prior to commencing any of the field activities defined in Section 3.0, all WCC personnel working on-site will supply certificate or equivalent, attesting to completing 40 hours of training as required by OSHA, in 29 CFR 1910.120, to the SSO. Site supervisors will be required to supply documentation indicating that an additional 8 hours of training has been completed. Escorted visitors may be allowed in a defined area without 40 hours training at the discretion of the WCC SSO and the WCC site coordinator.

Documentation concerning respirator fit testing, in accordance with OSHA, 29 CFR 1910.134 shall be required of any WCC employee wearing a respirator.

5.6 COMPLIANCE AGREEMENT

The Project Manager and the Baton Rouge Health and Safety Officer shall hold meetings with all WCC field personnel before work commences. During the meeting, all personnel shall be provided with a copy of this safety plan; the plan shall be reviewed and discussed and questions answered. Signed Compliance Agreement Forms shall be collected by the Project Manager and filed by the Baton Rouge Health and Safety Officer. Individuals refusing to sign the form will not be allowed to work on the site.

5.7 PROJECT MANAGER NOTIFICATION

All field personnel must inform the Project Manager or his designated representative before entering the site. The "buddy system" will be employed during all project work. This means that at least two members of the field crew must be on-site whenever work is performed. Personnel must be in visual contact with each other or carry two-way radios at all times.

5.8 PROJECT SAFETY LOG

A project safety log will be used to record the names, entry and exit dates and times of all WCC and subcontractor personnel and of project site visitors; accidents, injuries, and illnesses; incidence of safety infractions by field personnel; air quality and personal exposure monitoring data; and other information related to safety matters. All accidents, illnesses or other incidence shall be reported immediately to the WCC Project Manager, and the WCC Baton Rouge Health and Safety Officer and subsequently documented for filing on the HS-502 Incident Report Form.

5.9 PROHIBITIONS

- Smoking, eating, drinking, chewing gum or tobacco, storing food or food containers shall not be permitted on the work site. Good personal hygiene should be practiced by field personnel to avoid ingestion of contaminants or spread of contaminated materials.
- Ignition of flammable liquids within, on, or through improvised heating devices or space heaters.
- Approach or entry into areas or spaces where toxic or explosive concentrations of gases or dust may exist without proper equipment available to enable safety entry.
- Conduct of on-site operations without off-site back up personnel.

5.10 SITE SAFETY MEETINGS

During all site characterization activities, daily safety meetings will be held by the site safety officer to review and plan the specific health and safety aspects of scheduled work for that day.

LABORATORY CONSIDERATIONS

The laboratory director must be informed of any contaminant level in the samples that would require special handling procedures to prevent risk to the health and safety of laboratory personnel.

PERSONAL PROTECTIVE EQUIPMENT

This section outlines the general usage guidelines for personal protective equipment.

7.1 HEAD PROTECTION

Hard hats must be worn by all personnel working on-site.

7.2 EYE PROTECTION

Safety glasses with side shields or goggles must be worn by all personnel performing activities where potential for eye or face exposure exists due to splash, dust, or vapor, etc. An eyewash station will be set up by the site safety officer prior to commencing field activities and should be placed so that it could be used quickly in an emergency.

7.3 SKIN PROTECTION

Due to the potential for skin absorption and carcinogenic properties chemical resistant gloves and coveralls shall be worn by all personnel during subsurface and sample handling activities. These will be disposed of in a designated sealable drum after each use of when they become worn or punctured.

7.4 FOOTWEAR

Chemical-resistant boots with steel toes and shanks will be worn by field personnel engaged in the field activities at the site. Chemical-resistant booties can be substituted for chemical resistant boots, although work boots to be covered must always maintain steel toes and shanks.

7.5 RESPIRATORY PROTECTION

For respiratory protection against possible volatile organics, full-face air purifying respirators (APR) will be required if Level D air monitoring action levels are exceeded. Specific cartridges to be utilized with the APRs will be combination organic vapor/ammonia filter cartridges. All personnel must be properly fit-tested for the specific brand and size respirator to be used. Documentation of fit testing is to be provided to WCC SSO prior to commencement of work. A respirator which has not been successfully fit-tested cannot be used by an individual on the project. To ensure a proper fit, no facial hair will be allowed that will interfere with mask operation. The site safety officer will determine if facial hair represents such an interference. Air purifying respirators will only be used if the following conditions are met:

- The oxygen content of the air is greater than 19.5 percent.
- Concentration of air contaminants are known and monitored.
- The contaminants of concern all have good warning properties (i.e., odor threshold below PEL value).
- The protection factor is adequate and PELs are not exceeded.
- If concentrations of air contaminants exceed IDLH value, personnel must immediately evacuate.
- Cartridges are changed daily or whenever breakthrough occurs, whichever occurs first.
- Each person has been fit-tested for the specific brand and size of respirator used.
- The respirator is MSHA- and/or NIOSH-approved.

8.0

AIR QUALITY MONITORING

The primary goal of on-site air quality monitoring will be compliance with the specified contaminant action levels. The secondary goal will be documentation of personal exposures as required by OSHA 1920.120.

8.1 AIR QUALITY SURVEY

During modified Level D field activities at the site, an air quality survey will be performed utilizing an HNu-photoionization detector (PID) equipped with an 11.7 ev probe, or equivalent instrument to characterize volatile organics and ammonia concentrations on-site. Standard operating procedures for this instrument are attached as Appendix E. During Level C field activities, additional sampling utilizing colorimetric tubes specific for detecting chloroform, methylene chloride, and carbon tetrachloride will be used along with the HNu for total organic vapors. At least two sampling events utilizing each of these tubes will be conducted in the breathing zone of personnel closest to the subsurface activities at the site. Table 2 lists air monitoring action levels for Level D and C work.

TABLE 2
AIR MONITORING ACTION LEVELS FOR LEVEL C AND D WORK

Contaminant	Instrument*	Reading	Action Taken
Volatile Organic	HNu or equivalent	<5 ppm	Continued Work in Modified D Level
		5 - 25 ppm	Upgrade to Level C and Expand Work Zones; Commence additional colorimetric tube sampling
		>25 ppm	Evacuate Area

* Sustained reading above background (for 15 minutes continuous) which shall not be exceeded within worker breathing zones or exclusion zones.

EMERGENCIES/ACCIDENTS

A site map and direction to Vicksburg Hospital are included in Figure 1. Illnesses, injuries, and accidents occurring on-site must be attended to immediately in the following manner:

- Remove the injured or exposed person(s) from immediate danger.
- Render **FIRST AID** if necessary. Decontaminate affected personnel, if necessary.
- Call ambulance for transport to local. This procedure should be followed even if there is no apparent serious injury. Emergency numbers are listed on the following section.
- Evacuate other personnel on-site to a safe place until the engineer (assisted by the Site Safety Officer) determines that it is safe for work to resume.
- Report the accident to the Health and Safety Officer immediately.
- Develop procedures, in accordance with the Health and Safety Officer, Site Safety Officer, and Project Manager to prevent a recurrence.

In the event that an emergency site evacuation should be necessary for any reason, the Site Safety Officer will render an alarm using a horn and all personnel shall leave the site. The assembly point will be designated in the filed. Personnel will not return to the site until an all-clear has been received from the Site Safety Officer

9.1 EMERGENCY NUMBERS

For any on-site Emergency dial 911.

<u>Emergency Service</u>	<u>Telephone</u>
Fire Department	636-1121
Ambulance	911
Sheriff	636-1761
Vicksburg Police Department	636-2511
National Response Center (NRC)	1-800-424-8802
Poison Control Center	1-800-535-0525
Vicksburg Medical Center	636-2611
Mercy Regional Medical Center	631-2250

10.0

PERSONNEL ASSIGNMENTS

WCC personnel and subcontractors authorized to work on this project and enter the site are:

Project Manager:	Richard D. Karkkainen
Baton Rouge Health and Safety Officer:	Charles Self
Site Safety Officer:	Yong Goh
Field Personnel:	Mike Olson
Subcontractor:	Soil Testing Engineers, Inc.

10.1 PROJECT SAFETY PERSONNEL

Personnel responsible for implementing this Safety Plan are the Project Manager and Site Safety Officer. Their specific responsibilities and authorities for all accountable WCC personnel are listed in this plan as well as Table 2-1 of the WCC Health and Safety manual dated November 1990.

SAFETY PLAN COMPLIANCE AGREEMENT

I, _____ (print name), have received a copy of the Safety Plan for the Interim Measures, Groundwater Assessment, and RFI Field Investigation Workplans for VCC, Vicksburg, Mississippi (WCC Project No. 90B451C). I have read the plan, understand it, and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Signed:

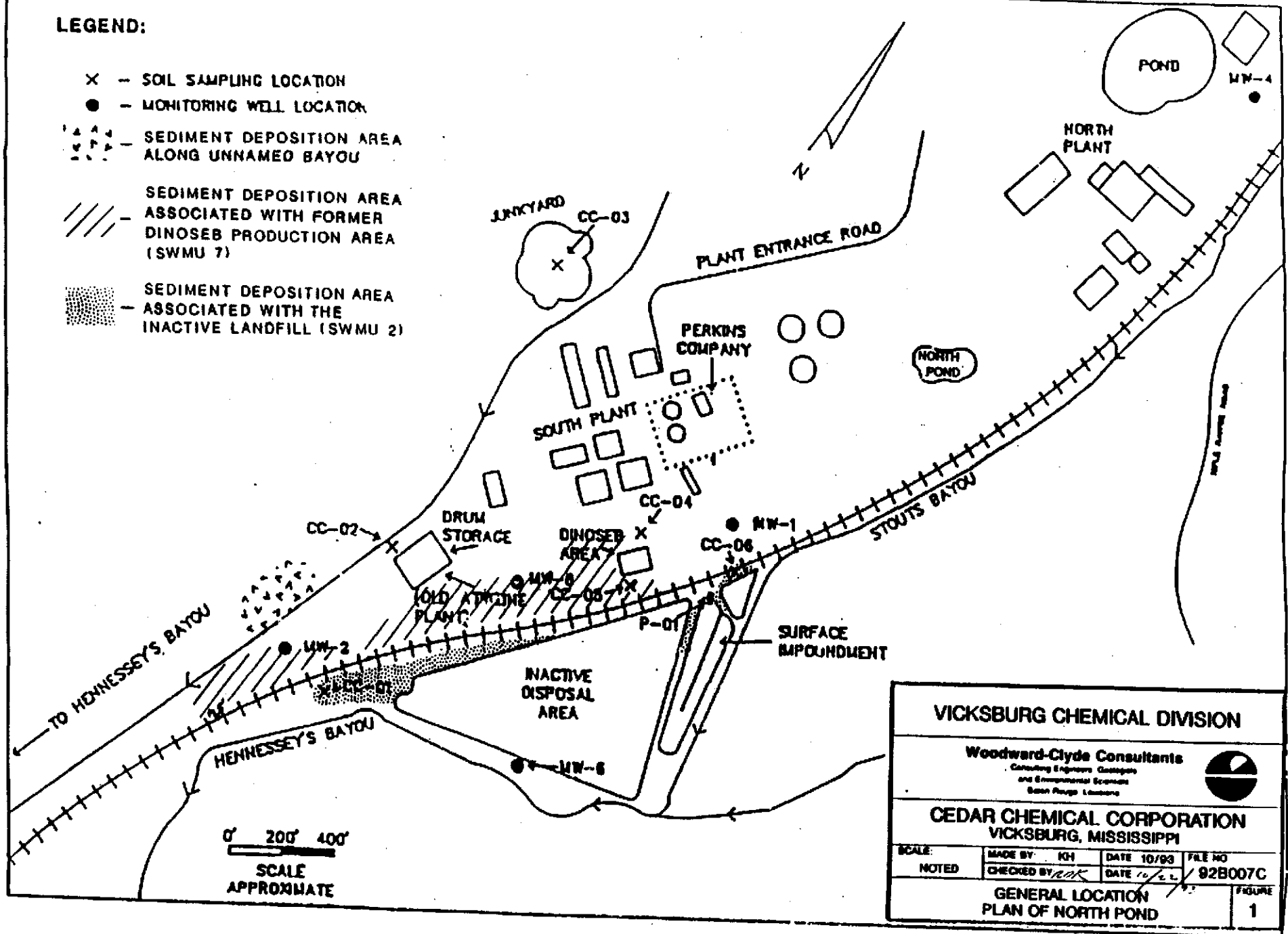
Signature

Date

Firm: _____

LEGEND:

- X - SOIL SAMPLING LOCATION
- - MONITORING WELL LOCATION
- ▲▲▲ - SEDIMENT DEPOSITION AREA ALONG UNNAMED BAYOU
- //// - SEDIMENT DEPOSITION AREA ASSOCIATED WITH FORMER DINOSEB PRODUCTION AREA (SWMU 7)
- - SEDIMENT DEPOSITION AREA ASSOCIATED WITH THE INACTIVE LANDFILL (SWMU 2)



VICKSBURG CHEMICAL DIVISION			
Woodward-Clyde Consultants Consulting Engineers, Geologists and Environmental Scientists Baton Rouge, Louisiana			
CEDAR CHEMICAL CORPORATION VICKSBURG, MISSISSIPPI			
SCALE:	MADE BY: KH	DATE 10/93	FILE NO.
NOTED	CHECKED BY: <i>AK</i>	DATE 10/93	92B007C
GENERAL LOCATION PLAN OF NORTH POND			FIGURE 1

APPENDIX A
HEAT STRESS CASUALTY PREVENTION PLAN

APPENDIX A

HEAT STRESS CASUALTY PREVENTION PLAN

Due to the increase in ambient air temperatures and the affects of protective outer wear decreasing body ventilation, there exists an increase in the potential for injury, specifically, heat casualties. Site personnel will be instructed in identification of a heat stress victim, the first-aid treatment procedures for the victim and the preventing of heat stress casualties.

A. IDENTIFICATION AND TREATMENT

1) Heat Exhaustion

- a) **Symptoms:** Usually begins with muscular weakness, dizziness, nausea, and staggering gait. Vomiting is frequent. The bowels may move involuntarily. The victim is very pale, his skin is clammy skin, and he may perspire profusely. The pulse is weak and fast, his breathing is shallow. He may faint unless he lies down. This may pass, but sometimes it remains and death could occur.
- b) **First Aid:** Immediately remove the victim to the Personnel Decontamination Reduction Zone in a shady or cool area with good air circulation. Remove all protective outer wear. Call a physician. Treat the victim for shock. (Make him lie down, raise his feet 6 to 12 inches and loosen all clothing.) Transport victim to a medical facility as soon as possible.

2) Heat Stroke

- a) Symptoms: This is the most serious of heat casualties due to the fact that the body excessively overheats. Body temperatures often are between 107 degrees to 110 degrees Fahrenheit. First there is often pain in the head, dizziness, nausea, oppression, and the skin is dry, red and hot. Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly.
- b) First Aid: Immediately evacuate the victim to a cool and shady area in the Personnel Decontamination Reduction Zone. Remove all protective outer wear and all personal clothing. Lay him on his back with his head and shoulders slightly elevated. It is imperative that the body temperature be lowered immediately. This can be accomplished by applying cold wet towels, ice bags, etc., to the head. Sponge off bare skin with cool water or place him in a tub of cool water. The main objective is to cool him without chilling him. Give no stimulants. Transport the victim to a medical facility as soon as possible.

B. PREVENTION OF HEAT STRESS

- 1) One of the major causes of heat casualties is the depletion of body fluids. On the site there will plenty of fluids available. Personnel should replace water and salts loss from sweating. Salts can be replaced by either 0.1 percent solution, more heavily salted foods, or commercial mixes such as Gatorade. The commercial mixes are advised for personnel on low sodium diets.
- 2) A work schedule should be established so that the majority of the work day will be during the morning hours of the day before ambient air temperature levels reach their highs.

- 3) A work/rest guideline will be implemented for personnel required to wear Level B or Level C protection. This guideline is as follows:

<u>Ambient Temperatures</u>	<u>Maximum Working Time</u>
Above 90°F	1/2 hour
80°-90°F	1 hour
70°-80°F	2 hours
60°-70°F	3 hours
50°-60°F	4 hours
40°-50°F	5 hours
30°-40°F	6 hours
Below 30°F	8 hours

A sufficient period will be allowed for personnel to "cool down". This may require shifts of workers during operations.

C. HEAT STRESS MONITORING

For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism. Monitoring of personnel wearing protective clothing should commence when the ambient temperature is 70 degrees Fahrenheit or above. Frequency of monitoring should increase as the ambient temperature increases or if slow recovery rates are indicated. When temperatures exceed 80 degrees Fahrenheit, workers must be monitored for heat stress after every work period.

Heart rate should be measured at the radial pulse for 30 seconds as early as possible in the resting period. The heart rate at the beginning of the rest period should not exceed 110 beats per minute. If the heart rate is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle should be shortened by 33 percent.

- Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period should not exceed 99 degrees Fahrenheit. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the oral temperature exceeds 99.7 degrees Fahrenheit at the beginning of the next period, the following work cycle should be further shortened by 33 percent. Oral temperature should be measured again at the end of the rest period to make sure that it has dropped below 99 degrees Fahrenheit.

- Body water loss due to sweating should be measured by weighing the worker in the morning and in the evening. The clothing worn should be similar at both weighings; preferably, the worker should be weighed nude. The scale should be accurate to plus or minus one-quarter pound. Body water loss should not exceed 1.5 percent of the total body weight. If it does, workers should be instructed to increase their daily intake of fluids by the weight lost.

Ideally, body fluids should be maintained at a constant level during the work day. This requires replacement of salt lost in sweat as well.

Good hygiene standards must be maintained by frequent changes of clothing and daily showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

APPENDIX B
SAFETY GUIDELINES FOR DRILLING

APPENDIX B

SAFETY GUIDELINES FOR DRILLING

Drill rig maintenance and safety is the responsibility of the drill rig operator. However, safety requires the attention and cooperation of every worker and visitor to the job. The following is provided as a general guideline for safe drilling practices onsite.

OFF-ROAD MOVEMENT OF DRILL RIGS

The following safety guidelines relate to off-road movement:

- o Before moving a drill rig, first walk the route of travel, inspecting for depressions, slumps, gullies, ruts and similar obstacles.
- o Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven or hilly ground.
- o Discharge all passengers before moving a drill rig on rough or hilly terrain.
- o Engage the front axle (for 4x4, 6x6, etc., vehicles or carriers) when traveling off-highway on hilly terrain.
- o Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill.
- o Attempt to cross obstacles such as small logs and small erosion channels or ditches squarely, not at an angle.
- o Use the assistance of someone on the ground as a guide when lateral or overhead clearance is narrow.

- o After the drill rig has been moved to a new drilling site, set all brakes and/or locks. When grades are steep, block the wheels.
- o Never travel off-road with the mast (derrick) of the drill rig in the raised or partially raised position.
- o Tie-down loads on the drill rig and support trucks during transport.

OVERHEAD AND BURIED UTILITIES

The use of a drill rig near electrical power lines and other utilities requires that special precautions be taken by both supervisors and members of the exploration crew. Electricity can shock, it can burn and it can cause death.

Overhead and buried utilities should be located, noted and emphasized on all boring location plans and boring assignment sheets.

Before raising the drill rig mast (derrick) on a site in the vicinity of power lines, walk completely around the drill rig. Determine what the minimum distance from any point on the drill rig to the nearest power line will be when the mast is raised and/or being raised. Do not raise the mast or operate the drill rig if this distance is less than 20 feet.

Keep in mind that both hoist lines and overhead power lines can be moved toward each other by the wind.

CLEARING THE WORK AREA

Prior to drilling, adequate site cleaning and leveling should be performed to accommodate the drill rig and supplies and provide a safe working area. Drilling should not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

NOTE: In coordination with the Drilling Crew, the Site Health and Safety Manager will review the precautions taken to insure that the drill rig is leveled and stabilized.

HOUSEKEEPING ON AND AROUND THE DRILL RIG

The first requirement for safe field operations is that the drilling crew safety supervisor understands and fulfills the responsibility for maintenance and "housekeeping" on and around the drill rig.

Suitable storage locations should be provided for all tools, materials and supplies so that they can be conveniently and safely handled without hitting or falling on a member of the drill crew or a visitor.

Avoid storing or transporting tools, materials or supplies within or on the mast (derrick) of the drill rig.

Pipe, drill rods, bits casing, augers and similar drilling tools should be orderly stacked on racks or sills to prevent spreading, rolling or sliding.

Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.

Work areas, platforms, walkways, scaffolding and other accessways should be kept free of materials, obstructions and substances such as ice, excess grease or oil that could cause a surface to become slick or otherwise hazardous.

Keep all controls, control linkages, warning and operation lights and lenses free of oil, grease and/or ice.

Do not store gasoline in any portable container other than a non-sparking, red container with a flame arrester in the fill spout and having the word "gasoline" easily visible.

SAFE USE OF HAND TOOLS

There are almost an infinite number of hand tools that can be used on or around a drill rig. "Use the tool for its intended purpose" is the most important rule. The following are a few specific and some general suggestions which apply to safe use of several hand tools that are often used on and around drill rigs.

- o When a tool becomes damaged, either repair it before using it again or get rid of it.
- o When using a hammer, any kind of hammer for any purpose, wear safety glasses and require all others near you to wear safety glasses.
- o When using a chisel, any kind of chisel, for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- o Keep all tools cleaned and orderly stored when not in use.
- o Replace hook and heel jaws when they become visibly worn.
- o When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

SAFE USE OF WIRE LINE HOISTS, WIRE ROPE AND HOISTING HARDWARE

The use of wire line hoists, wire rope, and hoisting hardware should be as stipulated by the American Iron and Steel Institute's Wire Rope Users Manual.

All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper weaving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting

hardware and any other feature that would lead to failure. Wire ropes should be replaced when inspection indicates excessive damage according to the wire rope users manual.

If a ball-bearing-type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to assure that the swivel freely rotates under load.

If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, do not hoist more than 1 foot (0.3m) of the drill rod column above the top of the mast (derrick), do not hoist a rod column with loose tool joints and do not make up, tighten or loosen tool joints while the rod column is being supported by a slipping device. If drill rods should slip back into the borehole, do not attempt to break the fall of the rods with your hands.

Most sheaves on drill rigs are stationary with a single-part line. The number of parts of line should never be increased without first consulting with the manufacturer of the drill rig. Wire ropes must be properly matched with each sheave.

The following procedures and precautions must be understood and implemented for safe use of wire ropes and rigging hardware.

Use tool-handling hoists only for vertical lifting of tools (except when angle-hole drilling). Do not use tool-handling hoists to pull on objects away from the drill rig; however, drills may be moved using the main hoist as the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.

When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.

When attempting to free a mired vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle or drill rig carrier and stay as far away as possible from the wire rope. Do not attempt to use tool hoists to free a mired vehicle or drill rig carrier.

To minimize shock loading of a wire rope, always apply loads smoothly and steadily.

Some additional safety guidelines that should be followed are:

- o Protect wire rope from sharp corners or edges.
- o Replace faulty guides and rollers.
- o Replace worn sheaves or worn sheave bearings.
- o Replace damaged safety latches on safety hooks before use.
- o Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- o Periodically inspect and test clutches and brakes of hoists.
- o Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles and other lifting aids.
- o Always wear gloves when handling wire ropes.
- o Do not guide wire ropes on hoist drums with your hands.
- o After installation of a new wire rope, lift a light load to allow the wire rope to adjust.
- o Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public or property are created.
- o Never leave a load suspended when the hoist is unattended.

- o Keep your hands away from hoists, wire rope, hoisting hooks, sheaves and pinch points as slack is being taken up and when the load is being hoisted.
- o Never hoist a load over members of the crew.

SAFE USE OF AUGERS

The following general procedures should be used when advancing a boring with continuous-flight or hollow-stem augers:

- o Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear and the engine running at low RPM.
- o The operator and tool handler should establish a system of responsibility for the various activities required for auger drilling, such as connecting and disconnecting auger sections and inserting and removing the auger fork. The operator must assure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.
- o Use only the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench or any other tools during rotation.
- o Whenever possible, use tool hoists to handle auger sections.
- o Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.

- o Never allow feet to get under the auger section that is being hoisted.
- o When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason whatever.
- o Never use your hands or feet to move cuttings away from the auger.
- o When cleaning augers, be sure the drill rig is in neutral and the augers are stopped from rotating.

SAFETY DURING ROTARY AND CORE DRILLING

Rotary drilling tools should be safety-checked before use. In particular, check for the following:

- o See that water swivels and hoisting plugs are lubricated and checked for frozen bearings before use.
- o Check rod chuck jaws periodically and replace them when necessary.
- o Check the capacities of hoists and sheaves against the anticipated weight on the drill rod string plus other expected hoisting loads. Inspect all cables daily.

These other special precautions should be taken for safe rotary or core drilling:

- o Drill rods should not be braked during lowering into the hole with drill rod chuck jaws.
- o Drill rods should not be held or lowered into the hole with pipe wrenches.
- o If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.

- o In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- o When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.
- o If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with a rough surface and fitted cover panels of adequate strength to hold drill rig personnel.
- o Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.
- o Inspect all hydraulic lines periodically and replace as needed.

START-UP

All drill rig personnel and visitors should be instructed to "stand-clear" of the drill rig immediately prior to and during starting of an engine.

Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the correct, non-actuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.

SAFETY DURING DRILLING OPERATIONS

Safety requires the attention and cooperation of every worker and site visitor.

Do not drive the drill rig from hole to hole with the mast (derrick) in the raised position.

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Before raising the mast (derrick) look up to check for overhead obstructions.

Before raising the mast (derrick), all drill rig personnel and visitors (with exception of the operator) should be cleared from the area immediately to the rear and the sides of the mast. All drill rig personnel and visitors should be informed that the mast is being raised prior to raising it.

Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig must be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set up. Lower the mast (derrick) only when leveling jacks are down and do not raise the leveling jack pads until the mast (derrick) is lowered completely.

Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.

The operator of a drill rig should only operate a drill rig from the position of the controls. The operator should shut down the drill engine before leaving the vicinity of the drill.

Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a drill rig or while on the job.

Watch for slippery ground when mounting dismounting from the platform.

All unattended boreholes must be adequately covered or otherwise protected to prevent drill rig personnel, site visitors or animals from stepping or falling into the hole. All open boreholes should be covered, protected, or backfilled adequately and according to local or state regulations on completion of the drilling project.

"Horsing around" within the vicinity of the drill rig and tool and supply storage areas should never be allowed, even when the drill rig is shut down.

Be careful when lifting heavy objects.

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Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.

Drilling operations should be terminated during an electrical storm.

APPENDIX C
CHEMICAL INFORMATION SHEETS

AMMONIA

- Hazardous substance (EPA)

Description: NH_3 , ammonia is a colorless, strongly alkaline, and extremely soluble gas with a characteristic pungent odor.

Code Numbers: CAS 7664-41-7 RTECS BO0875000 UN 1005

DOT Designation: Nonflammable gas.

Synonyms: Anhydrous ammonia.

Potential Exposures: Ammonia is used as a nitrogen source for many nitrogen-containing compounds. It is used in the production of ammonium sulfate and ammonium nitrate for fertilizers and in the manufacture of nitric acid, soda, synthetic urea, synthetic fibers, dyes, and plastics. It is also utilized as a refrigerant and in the petroleum refining and chemical industries. It is used in the production of many drugs (A-41) and pesticides (A-32).

Other sources of occupational exposure include the silvering of mirrors, glue-making, tanning of leather, and around nitriding furnaces. Ammonia is produced as a by-product in coal distillation and by the action of steam on calcium cyanamide, and from the decomposition of nitrogenous materials.

Incompatibilities: Strong oxidizers, calcium, hypochlorite bleaches, gold, mercury, silver, halogens.

Permissible Exposure Limits in Air: The Federal standard for ammonia is an 8-hour time-weighted average of 50 ppm (35 mg/m^3). NIOSH has recommended 50 ppm expressed as a ceiling and determined by a 5-minute sampling period. ACGIH as of 1983/84 has set TWA values of 25 ppm (18 mg/m^3). The tentative STEL value is 35 ppm (27 mg/m^3). The IDLH level is 500 ppm.

Determination in Air: Collection by midjet impinger and colorimetric analysis using Nessler's reagent (A-10). Ammonia may also be determined using long-duration detector tubes (A-11).

Permissible Concentration in Water: EPA in 1976 (A-3) proposed a limit of 0.02 mg/L (as unionized ammonia) for the protection of freshwater aquatic life. As of 1980, EPA (2) first proposed adding ammonia to the list of priority toxic pollutants and developing criteria for it, but then withdrew the proposal. NAS/NRC proposed (A-2) a limit of 0.5 mg/L for drinking water.

Routes of Entry: Inhalation of gas, ingestion, skin and eye contact.

Harmful Effects and Symptoms: Local — Contact with anhydrous liquid ammonia or with aqueous solutions is intensely irritating to the mucous membranes, eyes, and skin. Eye symptoms range from lacrimation, blepharospasm, and palpebral edema to a rise of intraocular pressure, and other signs resembling acute-angle closure glaucoma, corneal ulceration, and blindness. There may be corrosive burns of skin or blister formation. Ammonia gas is also irritating to the eyes and to moist skin.

Systemic — Mild to moderate exposure to the gas can produce headache, salivation, burning of throat, anosmia, perspiration, nausea, vomiting, and substernal pain. Irritation of ammonia gas in eyes and nose may be sufficiently intense to compel workers to leave the area. If escape is not possible, there may be severe irritation of the respiratory tract with the production of cough, glottal edema, bronchospasm, pulmonary edema, or respiratory arrest. Bronchitis or pneumonia may follow a severe exposure if patient survives. Urticaria is a rare allergic manifestation from inhalation of the gas.

Points of Attack: Lungs, respiratory system, eyes.

Medical Surveillance: Preemployment physical examinations for workers in ammonia exposure areas should be directed toward significant changes in the skin, eyes, and respiratory system. Persons with corneal disease, and glaucoma, or chronic respiratory diseases may suffer increased risk. Periodic examinations should include evaluation of skin, eyes, and respiratory system, and pulmonary function tests to compare with baselines established at preemployment examination.

First Aid: If this chemical gets into the eyes, irrigate immediately. If this chemical contacts the skin, flush with water immediately. If a person breathes in large amounts of this chemical, move the exposed person to fresh air at once and perform artificial respiration. When this chemical has been swallowed, get medical attention. Do not induce vomiting.

Personal Protective Methods: Where ammonia hazards exist in concentrations above the standard, respiratory, eye, and skin protection should be provided. Fullface gas masks with ammonia canister or supplied air respirators, both with full facepieces, afford good protection. In areas where exposure to liquid ammonia occurs, goggles or face shields, as well as protective clothing impervious to ammonia and including gloves, aprons, and boots should be required. Where ammonia gas or concentrated ammonia solution is splashed in eyes, immediate flooding of the eyes with large quantities of water for 15 minutes or longer is advised, followed at once by medical examination.

In heavy concentrations of ammonia gas, workers should be outfitted with complete self-contained protective suits impervious to ammonia, with supplied air source, and full headpiece and facepiece. Appropriate clothing should be worn to prevent any possible skin contact with liquids of >10% content or reasonable probability of contact with liquids of <10% content. Wear eye protection to prevent any possibility of eye contact with liquids of >10% NH_3 content. Employees should wash immediately when skin is wet or contaminated with liquids of >10% content. Remove nonimpervious clothing immediately if wet or contaminated with liquids containing >10% and promptly remove if liquid contains <10% NH_3 . Provide emergency showers and eyewash if liquids containing >10% NH_3 are involved.

Respirator Selection:

100 ppm: CCRS/SA/SCBA

300 ppm: CCRSF

500 ppm: GMS/SAF/SCBAF

Escape: GMS/SCBA

Disposal Method Suggested: Dilute with water, neutralize with HCl and discharge to sewer (A-38). Recovery is an option to disposal which should be considered for paper manufacture, textile treating, fertilizer manufacture and chemical process wastes (A-57).

References

- (1) National Institute for Occupational Safety and Health, *Criteria for a Recommended Standard: Occupational Exposure to Ammonia*, NIOSH Doc. No. 74-136, Washington, DC (1974).
- (2) U.S. Environmental Protection Agency, "Toxic Pollutant List: Proposal to Add Ammonia," *Federal Register*, 45, No. 2, 803-806 (January 3, 1980) Rescinded by *Federal Register*, 45, No. 232, 79692-79693 (December 1, 1980).
- (3) National Research Council, Committee on Medical and Biologic Effects of Environmental Pollutants, *Ammonia*, Baltimore, MD, University Park Press (1979).
- (4) Sax, N.I., Ed., *Dangerous Properties of Industrial Materials Report*, 2, No. 1, 65-68, New York, Van Nostrand Reinhold Co. (1982).
- (5) See Reference (A-61).
- (6) Sax, N.I., Ed., *Dangerous Properties of Industrial Materials Report*, 3, No. 3, 49-53, New York, Van Nostrand Reinhold Co. (1983).
- (7) See Reference (A-60).
- (8) Permezziani, L., Ed., *Encyclopedia of Occupational Health & Safety*, Third Edition, Vol. 1, pp 148-150, Geneva, International Labour Office (1983).

ATRAZINE

ATZ

Common Symptoms Irritation of skin and eyes Irritation of respiratory tract Aggravated asthma		Solid orange white Sinks in water
AVOID CONTACT WITH SOLID AND DUST PEOPLE AWAY Wear goggles and self-contained breathing apparatus Stay downwind and wear mask to "breathe clean" dust Remove and replace damaged respirator Notify local health and pollution control agencies		
Fire	Not flammable POISONOUS GASES MAY BE PRODUCED WHEN HEATED	
Exposure	CALL FOR MEDICAL AID DUST POISONOUS IF INHALED. Irritation to skin and eyes Mild irritation to throat If in eyes, flush eyes with water and flush with plenty of water If breathing is difficult, give oxygen SOLID POISONOUS IF SWALLOWED Irritation to skin and eyes Mild irritation to throat Flush mouth with plenty of water If in EYES, flush eyes with water and flush with plenty of water If SWALLOWED and victim is CONSCIOUS, have victim drink water If SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm	
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water streams. Notify local health and pollution control Notify operators of nearby water streams.	
1. RESPONSE TO EMERGENCY (See Response Methods Handbook) Have working water connections Should be removed Observe and protect streams		2. LABEL 2.1 Category: None 2.2 Signal: Not pertinent
3. CHEMICAL DEMONSTRATIONS 3.1 OD Concentration: Class 1 to be developed 3.2 Potency: $CaH_4N_4O_3$ 3.3 MSD/UN Classification: 6.1/1000 3.4 DOT ID No.: 1029 3.5 CAS Registry No.: 1912-24-9		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State: See Response: None 4.2 Color: White 4.3 Odor: Data not available
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Dust mask, goggles, rubber gloves 5.2 Symptoms Following Exposure: Irritation to skin and eyes, if inhaled, irritation to throat and stomach 5.3 Treatment of Exposure: EYES: Flush with clean water for 15 min. Flush with clean large amounts of water. INGESTION: No emetics induced. Induce vomiting and give a strong laxative and supportive therapy. 5.4 Threshold Limit Value: 5 mg/m ³ 5.5 Short Term Exposure Limit: Data not available 5.6 Toxicity by ingestion: Class 2 and not LD ₅₀ = 2000 mg/kg 5.7 LD ₅₀ Value: Data not available 5.8 Vapor (Gas) Effluent Characteristics: Vapors are irritating to eyes and throat 5.9 Liquid or Solid Effluent Characteristics: Causes irritation of the skin and the degree of irritation on short exposure and may cause severe-degree burns on long exposure 5.10 Oral Threshold: Data not available 5.11 LD ₅₀ Value: Data not available		

<div>6. FIRE HAZARDS</div> <div>6.1 Flash Point: Not determinable</div> <div>6.2 Flammable Limits in Air: Not determinable</div> <div>6.3 Fire Extinguishing Agents: Not pertinent</div> <div>6.4 Fire Extinguishing Agents: Not to be used Note: Data not available</div> <div>6.5 Special Hazards of Combustion Products: Irritating hydrogen cyanide and toxic gases of nitrogen may be formed.</div> <div>6.6 Solubility in Water: Not pertinent</div> <div>6.7 Ignition Temperature: Not pertinent</div> <div>6.8 Self-Heating: Not pertinent</div> <div>6.9 Boiling Point: Not pertinent</div> <div>6.10 Auto-ignition Temperature Data not available</div> <div>6.11 Decomposition: Not pertinent</div> <div>6.12 Flash Temperature: Data not available</div>	<div>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook)</div> <div>11</div>																										
<div>7. CHEMICAL REACTIVITY</div> <div>7.1 Reactivity with Water: No reaction</div> <div>7.2 Reactivity with Common Materials: No reaction</div> <div>7.3 Stability During Transport: Stable</div> <div>7.4 Reacting Agents: Not pertinent</div> <div>7.5 Polymerization: Not pertinent</div> <div>7.6 Inhibitor of Polymerization: Not pertinent</div> <div>7.7 Acid-Base Reaction: Not pertinent</div> <div>7.8 Reactivity Group: Data not available</div>	<div>11. HAZARD CLASSIFICATIONS</div> <div>11.1 Code of Federal Regulations: Not used</div> <div>11.2 HAS Hazard Rating for Bulk Water Temperature:<table><thead><tr><th>Category</th><th>Rating</th></tr></thead><tbody><tr><td>Fire</td><td>0</td></tr><tr><td>Health</td><td>0</td></tr><tr><td>Vapor Hazards</td><td>0</td></tr><tr><td>Liquid or Solid Hazards</td><td>2</td></tr><tr><td>Reactivity</td><td>0</td></tr><tr><td>Human Toxicity</td><td>3</td></tr><tr><td>Aquatic Toxicity</td><td>2</td></tr><tr><td>Acute Toxicity</td><td>3</td></tr><tr><td>Chronic Toxicity</td><td>3</td></tr><tr><td>Other Chemical</td><td>1</td></tr><tr><td>Water</td><td>1</td></tr><tr><td>Soil Reaction</td><td>0</td></tr></tbody></table></div> <div>11.3 EPA Hazard Classification: Not used</div>	Category	Rating	Fire	0	Health	0	Vapor Hazards	0	Liquid or Solid Hazards	2	Reactivity	0	Human Toxicity	3	Aquatic Toxicity	2	Acute Toxicity	3	Chronic Toxicity	3	Other Chemical	1	Water	1	Soil Reaction	0
Category	Rating																										
Fire	0																										
Health	0																										
Vapor Hazards	0																										
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Aquatic Toxicity	2																										
Acute Toxicity	3																										
Chronic Toxicity	3																										
Other Chemical	1																										
Water	1																										
Soil Reaction	0																										
<div>8. WATER POLLUTION</div> <div>8.1 Aquatic Toxicity: 12.5 mg/L (48 hr) In freshwater trout/TL/brown catfish</div> <div>8.2 Waterway Toxicity: >2000 mg/L (48 hr)</div> <div>8.3 Storage Oxygen Demand (SOD): Data not available</div> <div>8.4 Food Chain Concentration Potential: None</div>	<div>12. PHYSICAL AND CHEMICAL PROPERTIES</div> <div>12.1 Physical State at 15°C and 1 atm: Solid</div> <div>12.2 Molecular Weight: 215.7</div> <div>12.3 Boiling Point at 1 atm: 200°C</div> <div>12.4 Freezing Point: 34°F = 1°C = 34°F</div> <div>12.5 Critical Temperature: Not pertinent</div> <div>12.6 Critical Pressure: Not pertinent</div> <div>12.7 Specific Gravity: 1.32 at 20°C (solid)</div> <div>12.8 Liquid Surface Tension: Not pertinent</div> <div>12.9 Liquid Water Overhead Vapors: Not pertinent</div> <div>12.10 Vapor Phase Specific Gravity: Not pertinent</div> <div>12.11 Ratio of Specific Heats of Vapor Phase: Not pertinent</div> <div>12.12 Latent Heat of Vaporization: Not pertinent</div> <div>12.13 Heat of Combustion (solid): -6,200 Btu/lb = -4,200 cal/g = -170 kJ/mol</div> <div>12.14 Heat of Combustion (liquid): Not pertinent</div> <div>12.15 Heat of Combustion (gas): Not pertinent</div> <div>12.16 Heat of Polymerization: Not pertinent</div> <div>12.17 Heat of Fusion: Data not available</div> <div>12.18 Limiting Value: Data not available</div> <div>12.19 Heat Vapor Pressure: Data not available</div>																										
<div>9. SHIPPING INFORMATION</div> <div>9.1 Grades of Purity: Various grades, 75-95% Material with certain effects and certain characteristics</div> <div>9.2 Storage Temperature: Ambient</div> <div>9.3 Inert Atmosphere: Not pertinent</div> <div>9.4 Venting: Open</div>																											
<div>NOTES</div>																											

Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 22

CALCIUM OXIDE

(Revision C)

Issued: September 1978

Revised: April 1989

SECTION 1. MATERIAL IDENTIFICATION

28

Material: CALCIUM OXIDE

Description (Origin/Uses): Used in the manufacture of steel, aluminum, glass, and paper; also found in plaster, mortar, bricks, stucco, and in other building and construction materials.

Other Designations: Lime; Quicklime; Burnt Unslaked Lime; High-Calcium Lime; CaO;
CAS No. 1305-78-8

Manufacturer: Contact your supplier or distributor. Consult the latest edition of *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.



NFPA

HMIS

H	1	R	1
F	1	I	2
R	0	S	3
PPG*		K	0

*See sect. 8

SECTION 2. INGREDIENTS AND OCCUPATIONAL EXPOSURE LIMITS

Calcium Oxide, ca 100%

OSHA PEL

8-hr TWA: 5 mg/m³

ACGIH TLV, 1988-89

TLV-TWA: 2 mg/m³

Toxicity Data

Not Listed*

*Monitor NIOSH, RTECS (EW3100000), for future data.

SECTION 3. PHYSICAL DATA

Boiling Point: 5162 °F (2850 °C)

Melting Point: 4638 °F (2570 °C)

pH: >10 (Strongly Basic)

Molecular Weight: 56 g/mol

Solubility in Water (%): Reacts

Specific Gravity (H₂O = 1): 3.2 to 3.4

Appearance and Odor: A white or grayish white solid (it can appear yellowish or brownish if iron impurities are present; commercial calcium oxide is available in a wide variety of forms such as lumps, pellets, pebbles, and powders); odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point: *

Autoignition Temperature: *

LEL: *

UEL: *

Extinguishing Media: *Calcium oxide will not burn. Use an extinguishing agent that will put out the surrounding fire. Water reacts dangerously with calcium oxide and is not recommended as an extinguishing agent for fires that involve it. If water must be used, prevent it from coming into direct contact with the calcium oxide. If such contact is unavoidable, apply the water in flooding amounts to safely absorb the heat that will be generated. Unusual Fire or Explosion Hazards: Do not allow water to get inside containers of calcium oxide; reaction with the water will cause the calcium oxide to swell, generate heat, and burst its container. The heat generated by this reaction may ignite nearby combustible materials. Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Calcium oxide is stable in closed, airtight containers during routine work operations. Hazardous polymerization cannot occur. Chemical Incompatibilities: Calcium oxide can react dangerously with boric oxide and calcium chloride, boron trifluoride, chlorine trifluoride, fluorine, hydrofluoric acid, phosphorus pentoxide, and water. Conditions to Avoid: Control exposure to incompatible chemicals. Always establish the compatibility of calcium oxide with another material before using it in bulk operations by testing small quantities under appropriate conditions. Avoid exposing calcium oxide to air because it reacts with the ambient moisture and carbon dioxide. Hazardous Products of Decomposition: Oxides of calcium may be produced when calcium oxide reacts with other materials during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Calcium oxide is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Calcium oxide is a strongly alkaline material; its contact with the skin, eyes, or inhalation results in severe irritation. Dust containing 25 mg/m³ of this material causes strong nasal irritation; dust containing 9 to 10 mg/m³ does not. The presence of moisture on the skin or on the mucous membrane of the respiratory system increases the possibility of corrosive tissue damage (chemical burns). Dehydration and thermal effects (the heat generated from reaction with water) are contributing factors to the irritating properties of calcium oxide. Medical Conditions Aggravated by Long-Term Exposure: None reported. Target Organs: Skin, eyes, nose, and respiratory system. Primary Entry: Inhalation and contact with skin and eyes. Acute Effects: Irritation and burns to the skin, eyes, and nose; irritation and inflammation of the respiratory system: coughing; and sneezing. Chronic Effects: Ulceration and perforation of the nasal septum, pneumonia. May cause nails to become brittle and fissure (split). (Cont'd.)

SECTION 6. HEALTH HAZARD INFORMATION, continued**FIRST AID**

Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. An occupational ophthalmologist should monitor and treat the eye for calcium oxide burns. **Skin:** Do not rinse the affected area with water because severe skin damage is likely to occur if water is applied directly to the calcium oxide on the skin. Before wetting the calcium oxide, try to remove it from the skin with oil or grease; then apply water in a forcefully directed, powerful stream in flooding amounts that will mechanically and immediately remove the calcium oxide particles from the skin. **Inhalation:** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. **Ingestion:** Unlikely. Get in plant, paramedic, or community medical help for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid. **Note to Physician:** Severe exposure indicates hospitalization for 72 hours with careful monitoring for the delayed onset of pulmonary edema.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, prevent accidental contact between the spilled calcium oxide and water, and avoid generating dust. Cleanup personnel need protection against its contact with skin or eyes as well as against inhalation of its dust (see sect. 8). Carefully pick up the solid, creating a minimum of dust, and collect it in metal containers with covers for disposal. Flush the trace residue in the spill area to a drain, using plenty of water.

Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Follow all applicable Federal, state, and local regulations. Large amounts of calcium oxide may require neutralization by acid before disposal. Flush any residue to a sewer after diluting it properly. Alternatively, the waste calcium oxide can be used for neutralizing plant acid waste.

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations

Assigned the RCRA Hazardous Waste No. D003 (40 CFR 261.23)

Assigned the CERCLA Reportable Quantity (RQ): 100 lb (45.4kg) (40 CFR 302.5 (b))

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Consult Genium reference 88 for recommendations on selecting the proper respirator for use around calcium oxide. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres.

Other: Wear dry rubber gloves, boots, aprons, gauntlets, and coveralls.

Ventilation: Install and operate general and local ventilation systems powerful enough to maintain airborne concentrations of calcium oxide below the OSHA PEL standard cited in section 2.

Safety Stations: Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas.

Contaminated Equipment: Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from your shoes and equipment.

Other: Design all work operations in a way that does not generate dust and prevents water from being accidentally introduced into any part of a production system that contains calcium oxide.

Comments: Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store calcium oxide in sealed, dry, airtight containers in a cool, dry, well-ventilated area separate from incompatible chemicals (see sect. 5). Store it away from strong oxidizing agents, acids, organic materials, water, and combustibles.

Special Handling/Storage: Protect containers of calcium oxide from physical damage. Prevent water from contacting stored calcium oxide. To maintain the full effectiveness of this material, avoid extended contact with air.

Comments: Calcium oxide generates substantial heat when mixed with water. Prevent accidental mixing by following planned work procedures in all shipping, receiving, transferring, and production operations. When calcium oxide is deliberately mixed with water, undertake proper precautions to ensure that the resulting heat can be safely generated. *Always add calcium oxide to water; never add water to calcium oxide.*

Hazardous Materials Table (49 CFR 172.101)

DOT Shipping Name: Calcium Oxide

DOT Hazard Class: ORM-B

DOT ID No.: UN1910

DOT Label: None

References: 1, 26, 38, 84-94, 100, 116

Prepared by: PJ Igoc, BS; Industrial Hygiene Review: DJ Wilson, CIH; Medical Review: W Silverman, MD

MATERIAL SAFETY DATA SHEET

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No. 410

CARBON TETRACHLORIDE

Revisor A

Date December 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CARBON TETRACHLORIDE

OTHER DESIGNATIONS: Tetrachlormethane, Perchlormethane, Methane Tetrachloride, CCl_4 , GE Material D5850, CAS #000 056 235

MANUFACTURER: Available from several suppliers, including:
Linden Chemicals & Plastics

PO Drawer J,
Moundsville, WV 26041

Phone: (314) 843-1310

SECTION II. INGREDIENTS AND HAZARDS

Carbon Tetrachloride

*ACGIH (1980 Intended Changes List). OSHA 8-hr TWA is 10 ppm. NIOSH has proposed a 10-hr TWA of 2 ppm. ACGIH and NIOSH recommend labeling as a suspected human carcinogen. (skin) notation indicates absorption through the skin can contribute significantly to overall exposure.

ca 100

HAZARD DATA

8-hr TWA 5 ppm (skin)
or 30 mg/m^3 *

Human, oral
LD₅₀ 43 mg/kg

Human, inhalation
LC₅₀ 1000 ppm
TC₅₀ 20 ppm (CNS)

Hamsters and mice have developed cancer on long term feeding.

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C --- 76.7 Specific gravity, 25/4 C --- 1.585
Vapor pressure @ 20 C, mm Hg --- ca 91 Melting point, deg C --- -23
Vapor density (Air=1) --- 5.3 Volatiles, % --- ca 100
Solubility in water @ 20 C, wt % - 0.08 Molecular weight --- 153.8

Appearance & Odor: A clear, colorless liquid with a characteristic sweetish odor. Odor recognition threshold (100% of test panel): 21.4 ppm in air when prepared from CS_2 ; 100 ppm in air when prepared from CH_4 . Odor may not be objectionable at acutely toxic levels.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER

Extinguishing Media: It is nonflammable. Use that which is appropriate for the surrounding fire. Use water spray to cool fire-exposed containers.

When involved in a fire situation, this material will emit highly toxic and irritating fumes and gases. Metals, such as aluminum and magnesium, can react violently with carbon tetrachloride when hot or burning.

Firefighters must wear self-contained breathing apparatus and full protective gear to fight fires involving this material.

SECTION V. REACTIVITY DATA

This material is stable under normal conditions of handling and use. It does not polymerize.

Thermal-oxidative decomposition will produce toxic, corrosive fumes, including phosgene and hydrogen chloride.

Violent reactions or explosions can occur with incompatible materials, such as barium, lithium, sodium, and potassium metal, powdered aluminum, magnesium, dimethylformamide (above 65 C), fluorine, etc. (See NFPA, "Manual of Hazardous Chemical Reactions".)

SECTION VI. HEALTH HAZARD INFORMATION	TLV 5 ppm (skin) (See Sect. II)
<p>Carbon tetrachloride is highly toxic and irritating by inhalation and ingestion (mean lethal dose is 5-10 ml). It is toxic by skin absorption. Excessive exposure may result in CNS depression and/or gastrointestinal symptoms.* It is irritating to skin and eyes. Eye contact or systemic effects can produce visual disturbances (haze, blind spots, narrowing of visual field, etc.). Skin contacts can cause defatting & dermatitis.</p> <p>Kidney & liver damage can occur from severe acute or chronic exposure. It is a suspected carcinogen in humans.</p> <p style="text-align: center;">FIRST AID:</p> <p>Eye Contact: Flush eyes with running water for 15 minutes, including under the eyelids. Get medical help if irritation persists or when visual disturbances occur.</p> <p>Skin Contact: Remove contaminated clothing promptly. Wash exposed skin with soap and water. Get medical help for repeated or gross exposures.</p> <p>Inhalation: Remove to fresh air. Restore and/or support breathing; have qualified person administer oxygen if needed. Get medical help.</p> <p>Ingestion: Contact physician for gastric lavage. (If medical help and advice is not readily available, give water to drink and induce vomiting.)</p> <p>*Also cardiac arrhythmias.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Notify safety personnel when large spills occur. Evacuate area. Provided maximum exhaust ventilation. Clean-up personnel must use protection against contact and inhalation (see Sect. VIII). Contain spill; pick up liquid for disposal. Small spills and residues can be absorbed on paper, vermiculite, etc. and allowed to evaporate in a hood. Prevent release of CCl₄ to surface water or sewers. Spills or discharges in 24 hours of 5000 lb or more (proposed RQ* is 1000 lb) must be reported to U.S. Government.</p> <p>DISPOSAL: Consider recovery and reuse, if feasible. Scrap may be burned in approved, high temperature incinerator with scrubber or it may be disposed of as hazardous waste (EPA number U211 or F001 as a spent degreasing solvent under RCRA). Follow Federal, State and Local regulations.</p> <p>*Reportable Quantity.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide general and local exhaust ventilation to meet TLV. Exhaust hoods need 100 fpm min. face velocity. Ventilate sumps and low lying areas. Use air-supplied or self-contained respirators above TLV, with full face piece above 100 ppm.</p> <p>PVA or neoprene gloves and protective clothing needed to prevent skin contact. Wear safety goggles and/or face shield for eye protection.</p> <p>An eyewash station and chemical safety shower should be readily accessible.</p> <p>Provide preplacement and twice a year medical exams. Workers with obesity, diabetes, alcoholism or pulmonary problems should have a physician's approval before working with CCl₄. Retain medical records for 30 years after termination of employment.</p> <p>Provide training to those exposed to CCl₄ in the workplace. Monitor vapor levels in the workplace.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in closed containers in a cool, dry, well-ventilated, low fire-risk area. Protect containers against physical damage. Keep away from sources of heat, direct sunlight, and incompatible materials (see Sect. V). Prevent exposure of vapors to high temperature to prevent decomposition to toxic and corrosive gases and vapors. No smoking in areas where vapors may be present.</p> <p>Prevent contact with the skin or eyes. Avoid exposure to vapors. Use good personal hygiene.</p> <p>CCl₄ toxicity is markedly increased by the synergistic effects of alcohol. When possible, substitute a less hazardous solvent for CCl₄. DOT Classification - ORM-A</p> <p>DATA SOURCE(S) CODE: 1-12, 15, 16, 21-26, 31, 37, 38, 41</p>	
<div style="display: flex; justify-content: space-between;"> <div style="width: 40%; font-size: small;"> <p>Judgment as to the quality of information hereon for evaluation purposes is necessary. Judgments are made on the basis of the information hereon. No attempt is made to verify the information or to determine its accuracy or reliability. The user assumes all responsibility for the accuracy or reliability of such information for application to his own situation and for consequences of its use.</p> </div> <div style="width: 55%;"> <p>APPROVALS: MIS CRD <i>J. M. Wilson</i></p> <p>Industrial Hygiene and Safety <i>12-9-80</i></p> <p>MEDICAL REVIEW: 16 Dec. 1980</p> </div> </div>	

Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 53

CHLORINE
(Revision B)
Issued: July 1979
Revised: April 1988

25

SECTION 1. MATERIAL IDENTIFICATION

Material Name: CHLORINE

Description (Origin/Uses): Used mainly to manufacture chlorinated lime for bleaching fabrics; as a versatile reagent in organic chemistry; in water purification; and as a military poison gas (bertholite).

Other Designations: Bertholite; Molecular Chlorine; Cl_2 ; NIOSH RTECS No. FO2100000;
CAS No. 7782-50-5

Manufacturers: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS
H 3
F 0 R 1
R 1 I 4
PPG* S 4
*See sect. 8 K 0



SECTION 2. INGREDIENTS AND HAZARDS

Chlorine, CAS No. 7782-50-5

%
ca 100

EXPOSURE LIMITS

IDLH* Level: 30 ppm
OSHA PEL
Ceiling: 1 ppm, 3 mg/m³
TLV-STEL: 3 ppm, 9 mg/m³
NIOSH REL
15-Min Ceiling: 0.5 ppm, 1.45 mg/m³
Toxicity Data**
Rat, Inhalation, LC_{50} : 293 ppm (1 Hr)
Mouse, Inhalation, LC_{50} : 137 ppm (1 Hr)

*Immediately dangerous to life and health

**See NIOSH, RTECS, for additional data with references to irritative and mutagenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: ca -29°F (-34°C)

Vapor Pressure: >760 Torr (Normal Atmospheric Pressure)

Vapor Density (Air = 1): 1.4085 at 68°F (20°C)

Melting Point: ca -150°F (-101°C)

Molecular Weight: 71 Grams/Mole

Water Solubility: Slight

Appearance and Odor: A greenish yellow, noncombustible gas; pungent, suffocating, nauseating odor. Its odor-recognition threshold is reported to be ca 0.3 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

LOWER UPPER

Flash Point and Method

Autoignition Temperature

Flammability Limits in Air

% by Volume

Extinguishing Media: *Chlorine will not burn, but it supports combustion of materials already involved in a fire. Use agents that will extinguish the surrounding fire. Use a water spray to cool fire-exposed tanks and to protect personnel attempting to stop a chlorine leak.
Unusual Fire or Explosion Hazards: Chlorine is a reactive/explosive gas. Fight fires involving it from the maximum possible distance; this gas greatly increases the flammability hazards of other combustibles that are present. Warning: Flammable gases, vapors, and mists form dangerously explosive mixtures with chlorine gas.
Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Fire fighters must use the maximum personal protective equipment available. If possible, have specially trained personnel remove intact cylinders of chlorine from the fire area and protect them with any available resource such as directed water spray.

SECTION 5. REACTIVITY DATA

Chlorine is stable in closed, pressurized containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Chemical Incompatibilities: Chlorine reacts dangerously with acetylene, ammonia, hydrogen, ether, fuel gas, hydrocarbons, turpentine, finely divided metals, diborane, benzene, and acetaldehyde (see Genium ref. 84, pp. 49-28 and 491M-53 to 491M-56).

Conditions to Avoid: Do not allow open flame, unprotected heaters, lighted tobacco products, electric sparks, or excessive heat in work areas because chlorine gas can form explosive mixtures with other gases. Do not heat pressurized storage tanks or cylinders containing chlorine because they may explode. Do not allow chlorine to be directly exposed to incompatible chemicals (see above).

Hazardous Products of Decomposition: Toxic gases such as carbon monoxide, phosgene, and hydrogen chloride (Genium Industrial MSDSs 35, 66, 30) can be produced in fires involving chlorine and other combustibles.

SECTION 6. HEALTH HAZARD INFORMATION

Chlorine is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks, Warning: This material is a powerful respiratory irritant. The most important acute health effect of exposure is lung damage from hydrochloric acid (HCl) caused by the reaction of chlorine with the moisture in the upper respiratory tract (URT). Fatal pulmonary edema (lungs filled with fluid) may be delayed from 24 to 48 hours after exposure. Erosion of teeth, decreased lung capacity, and increased susceptibility to tuberculosis are chronic effects in workers who handle this gas. **Medical Conditions Aggravated by Long-Term Exposure:** Cardiac, pulmonary, or respiratory problems. Administer preplacement and periodic medical exams emphasizing the respiratory system to workers who regularly handle chlorine. **Target Organs:** Respiratory system. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Burning and severe irritation of the eyes, skin, and URT; wheezing, shortness of breath; nausea; vomiting; headache; dizziness; and (delayed) pulmonary edema. **Chronic Effects:** Reduced respiratory capacity may result from chronic low-level exposure to chlorine.

FIRST AID: **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Skin contact with chlorine causes severe damage from frostbite (cryogenic injury) as well as chemical burns. Irrigate the area with water and treat the exposed person accordingly. **Inhalation.** Remove exposed person to fresh air; restore and/or support his or her breathing as needed. Recommended treatment includes administering pure oxygen gas (O₂) as soon as symptoms of exposure develop (Genium ref. 39, p. 1975). Observe exposed person for respiratory effects. **Ingestion.** This type of exposure to chlorine is highly unlikely because it is a gas.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Preplan and carefully explain proper emergency procedures to relevant personnel. Notify safety personnel, evacuate all non-essential personnel, provide maximum explosion-proof ventilation, and eliminate all sources of ignition immediately. Cleanup personnel must wear protection against contact with and inhalation of vapor (see sect. 8). Try to shut off the flow of chlorine gas. Use a water spray to protect personnel attempting to stop the leak.

Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z): Not Listed

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste: Listed without Number

CERCLA Hazardous Substance, Reportable Quantity: 10 lbs (4.54 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks) wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves; boots; aprons; and clean, impervious, body-covering clothing to prevent any possibility of skin contact. **Ventilation:** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of chlorine gas strictly below the OSHA PEL standard cited in section 2. Make all ventilation systems of maximum explosion-proof design, e.g., nonsparking, electrically grounded and bonded, etc. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling. **Contaminated Equipments:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do not wear contact lenses in any work area. **Other:** Use enclosed-containment processing operations; otherwise, the ventilation systems may not be able to keep airborne levels of chlorine below the legal ceiling limit of 1 ppm (3 mg/m³) set by OSHA. Automatic air-monitoring sensing equipment connected to an alarm system is recommended for continual-use operations. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area. Avoid prolonged skin contact with this material.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store chlorine in a cool, dry, well-ventilated area away from organics, sources of ignition, any flammable or explosive materials, cylinders containing oxygen, and incompatible chemicals (see sect. 5). Use outside or detached storage. Store cylinders upright and secure them tightly. **Special Handling/Storage:** Chlorine is shipped/stored as a pressurized gas in cylinders or tank cars. Protect them against physical damage and regularly inspect them for cracks, leaks, or faulty valves. Follow standard safety procedures for handling compressed, corrosive gases. Electrically ground and bond all containers used in shipping and transfer operations to prevent static sparks. Do not drag or slide cylinders containing chlorine; move them in a carefully supervised manner with a suitable hand truck. Do not smoke in use or storage areas. **Engineering Controls:** All engineering systems (ventilation, production, etc.) must be of maximum explosion-proof design. Use chlorine in closed engineering systems to prevent dispersion of this gas into general work areas. Monitor all piping systems, reactor vessels, and holding tanks for unwanted moisture contamination or buildup. Liquid chlorine levels should be less than 85% of a tank's or cylinder's capacity. **Comments:** Perform all operations with chlorine carefully to prevent accidental ignition of explosive mixtures. Prevent any contact with incompatible chemicals (see sect. 5). Keep the valve-protection cap in place until immediately before using chlorine. Insert a check valve or trap into the transfer line to prevent a dangerous backflow into the original container. Use a pressure-reducing regulator when connecting a storage vessel to a lower-pressure piping system. A trained chemist or safety specialist familiar with the physical and chemical properties of this gas should be present during all work operations.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Chlorine

DOT Class: Nonflammable Gas

References: 1, 2, 12, 73, 84-94, 100, 103.

DOT Label: Nonflammable Gas and Poison

DOT ID No. UN1017

IMO Label: Poison Gas

IMO Class: 2.3

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Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

Material Safety Data Sheet

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No. 315

CHLOROFORM
(Revision D)
Issued: August 1979
Revised: April 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: CHLOROFORM

Description (Origin/Uses): Used as a solvent for fats, oils, rubber, alkaloids, waxes, and resins; as a cleansing agent.

Other Designations: Trichloromethane; CHCl_3 ; NIOSH RTECS No. FS9100000; CAS No. 0067-66-3

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS

H 2

F 0

R 0

PPG*

*See sect. 8

R 1

I 3

S 2

K 0

SECTION 2. INGREDIENTS AND HAZARDS

Chloroform, CAS No. 0067-66-3

%
Ca 100

EXPOSURE LIMITS

OSHA PEL

Ceiling: 50 ppm, 240 mg/m³

ACGIH TLV, 1987-88

TLV-TWA: 10 ppm, 50 mg/m³

NIOSH REL

Ceiling: 2 ppm, 9.78 mg/m³

Toxicity Data*

Human, Oral, LD₅₀: 140 mg/kg

Rat, Oral, LD₅₀: 908 mg/kg

*See NIOSH, RTECS, for additional toxicity data with references to mutagenic, reproductive, tumorigenic, and irritative effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 142°F (61°C)

Melting Point: -82.3°F (-63.5°C)

Vapor Pressure: 158.4 Torr at 68°F (20°C)

Vapor Density (Air = 1): 4.13

Water Solubility (%): 0.822 ml of CHCl_3 per 100 ml of H_2O at 68°F (20°C)

% Volatile by Volume: 100

Molecular Weight: 119 Grams/Mole

Specific Gravity ($\text{H}_2\text{O} = 1$): 1.484 at 68°F (20°C)

Appearance and Odor: A heavy, colorless, clear, volatile liquid; characteristic, pleasant, ethereal, sweet odor (recognition threshold: 0.3 mg/m³); sweet taste.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
.	.	% by Volume	.	.

Extinguishing Media: *Chloroform does not burn. Use an agent that will put out the surrounding fire.

Unusual Fire or Explosion Hazards: None reported.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Chloroform is stable if kept in closed containers and protected from air and sunlight. It does not undergo hazardous polymerization; however, even when stabilized with ethanol, this material develops acidity from prolonged exposure to air and light.

Chemical Incompatibilities: This material is incompatible with strong alkalis.

Conditions to Avoid: Avoid prolonged exposure to air and light and to strong alkalis.

Hazardous Products of Decomposition: Toxic and corrosive gases like hydrochloric acid (HCl), chlorine (Cl_2), carbon monoxide (CO), and oxides of chlorine (ClO_x) can be produced during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Chloroform is listed as a suspected human carcinogen by ACGIH.

Summary of Risks: Exposure to this material affects the central nervous system (anesthesia); heart (arrhythmia, ventricular tachycardia, bradycardia); liver (necrosis, hepatoma); kidney (necrosis); and it is an embryonic toxin. Fatalities are associated with cardiovascular depression and ventricular fibrillation.

Medical Conditions Aggravated by Long-Term Exposure: Ailments of the heart, liver, and kidneys may be worsened by exposure to chloroform. **Target Organs:** Liver, kidneys, heart, skin, eyes. **Primary Entry:** Skin contact, inhalation. **Acute Effects:** Dizziness, mental dullness, nausea, headache, fatigue, and anesthesia. **Chronic Effects:** Possible cancer.

FIRST AID

Eyes: Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin:** Immediately wash the affected area with soap and water. **Inhalation:** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed.

Ingestion: Never give anything by mouth to someone who is unconscious or convulsing. If the exposed person is responsive, give him or her several glasses of milk or water to drink and induce vomiting. Repeat if large quantities were ingested.

Comments: Workers who are regularly exposed to chloroform require preplacement and periodic medical exams emphasizing kidney, liver, skin, and central nervous system functions. Carefully evaluate each exposure that produces a noticeable effect to determine the extent to which factors like alcohol or drugs have affected it.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel of a chloroform spill or leak. Provide ventilation. Cleanup personnel need protection against contact with and inhalation of vapor (see sect. 8). Chloroform vapor is heavier than air and will collect in low-lying areas. Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.

Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste, No. U044

CERCLA Hazardous Substance, Reportable Quantity: 5000 lbs (2270 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield as a supplementary protective measure. Follow the eye- and face-protection guidelines in 29 CFR 1910.133. **Respirator:** Wear a NIOSH-approved respirator per the NIOSH Pocket Guide to Chemical Hazards for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow the respirator guidelines in 29 CFR 1910.134. For emergency or nonroutine use (e.g., cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres. **Other:** To prevent contact with skin, wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specific work environment. **Ventilation:** Install and operate general and local ventilation systems that are powerful enough to maintain airborne levels of chloroform below the OSHA PEL standard cited in section 2. **Safety Stations:** Make eyewash stations, washing facilities, and safety showers available in use and handling areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area. Avoid inhalation of vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store chloroform in closed containers away from light and alkalis.

Special Handling/Storage: Protect containers from physical damage. Do not transfer chloroform through plastic or rubber hoses or pipes.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Chloroform

DOT Class: ORM-A

DOT Label: None

DOT ID No. UN1888

IMO Label: Poison

IMO Class: 6.1

References: 1, 2, 12, 73, 84-94, 100, 103.

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Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

**CEDAR CHEMICAL CORPORATION
MEMPHIS, TENNESSEE**

MATERIAL SAFETY DATA SHEET
Equivalent to OSHA form 174

PRODUCT NAME: TECHNICAL DINOSEB DATE: 08/15/86 PAGE 1
EPA REG. NO.: 56077-3

SECTION I

Manufacturer's Name: Cedar Chemical Corporation
5100 Poplar Ave. 24th Floor
Memphis, TN 38157
Emergency Phone Number: 1-800-324-9300
Information Phone Number: 1-601-636-1231
Prepared by: M. S. Bernard

SECTION II HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

INGREDIENT	OSHA PEL	ACGIH TLV	PERCENT
Dinoseb	n/d	0.3mg/m ³	95.00
Dinoseb (2-sec-butyl-4,6-dinitrophenol)			
CAS = 88-83-7			
Impurities	n/d	n/d	5.00

SECTION III PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point(°F)	above 212	Specific Gravity	1.258
Vapor Pressure(mm Hg.)	below 1	Melting Point(°F)	90
Vapor Density(Air=1)	n/a	Evaporation Rate	n/d
Solubility in Water:	0.0052g/100ml		
Appearance and Odor:	Brown solid, organic acid odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point(Method Used): 350.6°F TCC
Flammable Limits: LEL- n/d UEL- n/d
Extinguishing Media:
Water Fog, Foam, Alcohol Foam, CO₂, and Dry Chemical

CONTINUED ON PAGE 2

Special Fire Fighting Procedures:

Self-contained air supply. Confine water used in fire fighting.

Unusual Fire and Explosion Hazards:

Noxious fumes may form. Material undergoes rapid exothermic decomposition at 190°C. Vapors may ignite.

SECTION V REACTIVITY DATA

Stability: Stable in normal use and storage.

Conditions to Avoid: Heating above 100°C. Product undergoes rapid exothermic decomposition at 190°C. Avoid ignition sources.

Incompatibility: Strong Bases and Strong Oxidizers

Hazardous Decomposition or Byproducts: Oxides of Nitrogen

Hazardous Polymerization: Will not occur. No known conditions to avoid.

SECTION VI HEALTH HAZARD DATA

Route(s) of Entry: Inhalation: Moderate Toxicity
Skin: Readily Absorbed
Ingestion: Highly Toxic

Health Hazards (Acute and Chronic):

Oral Ingestion: High Single Dose Oral Toxicity.
LD₅₀ for Rats 25 mg/kg.
May be fatal if swallowed.

Eye Contact: May cause severe irritation and corneal injury. Corneal injury should heal in 1-2 weeks.

Skin Contact: May cause slight irritation or mild burn. Colors the skin yellow.

Skin Absorption: Readily absorbed through skin. high toxicity. LD₅₀ rabbits 80mg/kg.

Inhalation: May be irritating. Cedar industrial guide for Dinoseb is 0.3 mg/m³.

Carcinogenicity: NTP: Negative
IARC Monographs: Negative
OSHA Regulated: Negative.

Signs and Symptoms of Exposure: Fatigue, sweating, thirst, and fever.
Increased metabolic rate.

Medical Conditions Generally Aggravated by Exposure: Liver and kidney problems may be aggravated by extreme exposure.

Emergency and First Aid Procedures:

- Oral ingestion:** Toxic by ingestion. Induce vomiting and seek medical help immediately.
- Eye Contact:** Flush immediately with continuous irrigation with flowing water for at least thirty minutes. Seek medical consultation immediately.
- Skin Contact:** Immediately flush skin with plenty of water for at least fifteen minutes while removing contaminated clothing. Consult physician. Wash clothing before reuse.
- Inhalation:** Remove to fresh air if effects occur. Consult physician.

Note to Physician:

Eyes: Stain for evidence of corneal injury. If cornea is burned, instill antibiotic steroid preparation frequently. Consult ophthalmologist. May cause temporary injury.
 Overexposure: Treat for symptoms. No specific antidote.
 Human effects not established.

SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to Be Taken in Case Material Is Released or Spilled:

Use proper safety equipment. Absorb spill with absorbant inert material such as oil-dry. Dike area for large spills. Keep out of streams and water supplies.

Waste Disposal Method:

Dispose of in non-crop area away from water supplies or in an approved landfill in accordance with State, Federal, and local regulations.

Precautions to Be Taken in Handling and Storing:

Do not get on skin, on clothing, or in eyes. Keep out of reach of children.

Other Precautions:

Do not breathe spray mists. Keep away from heat or flame.

SECTION VIII CONTROL MEASURES

Respiratory Protection:

None normally needed. During spraying use organic vapor respirator.

Ventilation: Required to control level of dinoseb.

Protective Gloves: Impervious rubber gloves

Eye Protection: Chemical workers' goggles

Other Protective Clothing or Equipment: Rubber boots and apron and body-covering clothing.

Work/Hygenic Practices: Shower after handling.

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP.

No. 385

ETHYL BENZENE

(Revision A)

Issued: August 1978

Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: ETHYL BENZENE

Description (Origin/Uses): Used as a solvent and as an intermediate in the production of styrene monomer.

Other Designations: Phenylethane; Ethylbenzol; C_8H_{10} ; CAS No. 0100-41-4

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.



NFPA

HMIS

H	2	R	1
F	3	I	3
R	0	S	2
PPG*		K	4

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

Ethyl Benzene, CAS No. 0100-41-4

%

Ca 100

EXPOSURE LIMITS

OSHA PELs

8-Hr TWA: 100 ppm, 435 mg/m³

15-Min STEL: 125 ppm, 545 mg/m³

ACGIH TLVs, 1988-89

TLV-TWA: 100 ppm, 435 mg/m³

TLV-STEL: 125 ppm, 545 mg/m³

Toxicity Data*

Human, Inhalation, TC₅₀: 100 ppm (8 Hrs)

Rat, Oral, LD₅₀: 3500 mg/kg

*See NIOSH, RTECS (DA0700000), for additional data with references to reproductive, irritative, and mutagenic effects.

SECTION 3. PHYSICAL DATA

Bolling Point: 277°F (136°C)

Melting Point: -139°F (-95°C)

Vapor Pressure: 7.1 Tons at 68°F (20°C)

Vapor Density (Air = 1): 3.7

% Volatile by Volume: Ca 100

Molecular Weight: 106 Grams/Mole

Solubility in Water (%): Slight

Specific Gravity (H₂O = 1): 0.86258 at 77°F (25°C)

Appearance and Odor: A clear, colorless, flammable liquid; characteristic aromatic hydrocarbon odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method: 64°F (18°C) CC

Autoignition Temperature: 810°F (432.22°C)

LEL: 1% v/v

UEL: 6.7% v/v

Extinguishing Media: Use foam, dry chemical, or carbon dioxide to put out ethyl benzene fires. A water spray may be ineffective in extinguishing the fire, because it can scatter and spread the burning liquid. Use water spray to cool fire-exposed containers of ethyl benzene, to disperse ethyl benzene vapor, and to protect personnel attempting to stop an ethyl benzene leak. Unusual Fire or Explosion Hazards: This liquid can readily form explosive vapor-air mixtures, especially when heated. Ethyl benzene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back to its origin. Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Ethyl benzene is stable in closed containers during routine operations. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Hazardous chemical reactions can occur between ethyl benzene and strong oxidizing agents, acids, ammonia, and bases. Conditions to Avoid: Avoid any exposure to sources of ignition such as heat, sparks, open flame, and lighted tobacco products, etc., and to incompatible chemicals. Use caution when entering confined spaces, particularly low-lying areas where explosive concentrations of ethyl benzene vapor may be present. Provide good ventilation to such areas to prevent the concentration of this vapor. Hazardous Products of Decomposition: Thermal-oxidative degradation can include toxic gases such as carbon monoxide and/or aromatic hydrocarbon gases.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Ethyl benzene is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: Ethyl benzene vapor is severely irritating to the eyes and to the mucous membranes of the respiratory system. Sustained inhalation of excessive levels can cause depression of the central nervous system (CNS) characterized by dizziness, headache, narcosis, and coma. Skin contact with liquid ethyl benzene causes irritation; dermatitis and defatting can also develop. The acute oral toxicity of ethyl benzene is low; however, ingestion of it presents a serious aspiration hazard. Aspirating even a small amount into the lungs can result in extensive edema (lungs filled with fluid) and hemorrhaging of the lung tissue. No systemic effects are expected at the levels that produce pronounced, unignorable, disagreeable skin and eye irritation. The TLVs cited in section 2 are set to prevent this intolerable irritation. Medical Conditions Aggravated by Long-Term Exposure: None reported. Target Organs: Skin, eyes, respiratory system, and CNS. Primary Entry: Inhalation, skin contact. Acute Effects: Irritation of the skin, eyes, and respiratory system. Also, cardiac-rhythm disturbance due to sensitization: acute bronchitis, bronchospasm, pulmonary and laryngeal edema; euphoria; headache; giddiness; dizziness; and incoordination, as well as possible depression; confusion; and coma. Chronic Effects: None reported. First Aid: Eyes. Immediately

SECTION 6. HEALTH HAZARD INFORMATION, cont.

Flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. Skin. Rinse the affected area with plenty of water, then wash it with soap and water. Inhalation. Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Ingestion. Unlikely. Should this type of exposure occur, the aspiration hazard must be considered. Do not induce vomiting unless directed to do so by a physician. To prevent aspiration by spontaneous vomiting, keep the victim's head low (between his or her knees). Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid. Note to Physician: Professional judgment is required as to whether or not to induce vomiting because of the possibility of aspiration. A gastric lavage may be administered, followed by saline catharsis, if this procedure is appropriate to the specific incident. Monitor cardiac and pulmonary functions.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation. Cleanup personnel need protection against skin or eye contact with this liquid as well as inhalation of its vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways. Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).

EPA Designations (40 CFR 302.4)

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), §§ 311 (b) (4) and 307 (a).

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent prolonged or repeated skin contact with this material. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area. Do not inhale ethyl benzene vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store ethyl benzene in closed containers in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage. **Special Handling/Storage:** Outside, isolated, detached, or remote storage is recommended for large quantities of ethyl benzene. Isolate bulk storage areas from acute fire hazards. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. To prevent static sparks, electrically ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations. **Other:** Use safety cans for transferring small amounts of ethyl benzene.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Ethyl Benzene

DOT Hazard Class: Flammable Liquid

ID No. UN1175

DOT Label: Flammable Liquid

DOT Packaging Exceptions: 49 CFR 173.118

DOT Packaging Requirements: 49 CFR 173.119

IMO Shipping Name: Ethylbenzene

IMO Hazard Class: 3.2

IMO Label: Flammable Liquid

IMDG Packaging Group: II

References: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

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Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: W Silverman, MD

METHANEARSONIC ACID, SODIUM SALT

MSA

Common Synonyms Disodium methanearsonate Disodium methanearsonic acid MSMA OSMA Disodium methyl arsonate Methylarsonic acid sodium salt		Solid Solid may react or give off water, heat and solution when with water.	Crystalline solid Solution may be red or green	Caution					
See paragraph 4 Section Avoid contact with skin and clothing Avoid eye contact Avoid contact with food and drink Avoid contact with water Avoid contact with heat and fire Avoid contact with strong acids and bases									
Fire		Not dangerous POISONOUS GASES ARE PRODUCED WHEN HEATED May produce and/or decompose into toxic gases							
Exposure		CALL FOR MEDICAL AID SOLID OR SOLUTION Irritating to skin and eyes If swallowed, may cause nausea, vomiting, or loss of consciousness Remove contaminated clothing and shoes Flush affected areas with plenty of water If in EYES, flush eyes with water and flush with plenty of water If SWALLOWED and victim is CONSCIOUS, have victim drink water If SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm							
Water Pollution		Dangerous to aquatic life at high concentrations May be dangerous if it enters water bodies Avoid contact with food and drink Avoid contact with water Avoid contact with heat and fire							
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Wash with copious water Do not inhale Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Poison 2.2 Class: 6							
3. CHEMICAL DESIGNATIONS 3.1 OS Concentration Class: Not used 3.2 Formula: CH ₃ AsO ₂ (OH) ₂ CH ₃ AsO ₂ (OH) ₂ ·H ₂ O 3.3 MSD/UN Designation: 6.1/1587 3.4 DOT ID No.: 1587 3.5 CAS Registry No.: 2152-30-4		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State for shipping: Solid or water solution 4.2 Color: Colorless, contains may contain red or green dyes 4.3 Odor: None							
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Protective clothing to prevent contact with toxic chemical vapors 5.2 Symptoms Following Exposure: Symptoms occurring by exposure include skin irritation, burning, itching, and redness, and respiratory irritation. Acute toxicity observed by irritation, vomiting, diarrhea, convulsions. About 1 ounce to 1 pound must be taken to cause these symptoms. 5.3 Treatment of Exposure: INGESTION: Flush mouth with water and repeat. Give a glass of water. If no vomiting occurs, give a glass of water. If vomiting occurs, give a glass of water. If no vomiting occurs, give a glass of water. If vomiting occurs, give a glass of water. 5.4 Threshold Limit Value: Data not available 5.5 Short Term Exposure Limit: Not determined 5.6 Toxicity by Ingestion: Grade 2, LD ₅₀ = 0.5-0.6 g/kg (rat) 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Physical Characteristics: None 5.9 Liquid or Solid Physical Characteristics: Irritation contact may cause skin sensitivity 5.10 Skin Threshold: Not determined 5.11 Skin Value: Data not available									
6. FIRE HAZARDS 6.1 Flash Point: Not determined 6.2 Flammable Limit in Air: Not determined 6.3 Fire Extinguishing Agents: Not determined 6.4 Fire Extinguishing Agents: Not to be used 6.5 Special Hazards of Combustion: Products: Toxic gases may be generated in fire. 6.6 Behavior in Fire: Not determined 6.7 Ignition Temperature: Not determined 6.8 Self-Heating: Not determined 6.9 Polymerization: Not determined 6.10 Adiabatic Flame Temperature: Data not available 6.11 Decomposition: Not to be used 6.12 Flash Temperature: Data not available					10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) 00				
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: None 7.2 Reactivity with Common Materials: None 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for acids and bases: Not determined 7.5 Polymerization: Not determined 7.6 Oxidation: Not determined 7.7 Water Reactions: Not to be used 7.8 Reactivity Group: Data not available					11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Poison, 2 11.2 GHS Hazard Rating for Skin Water: Not determined 11.3 GHS Hazard Classification: Not used				
8. WATER POLLUTION 8.1 Aquatic Toxicity: > 1000 ppm/L (48 hr) and/or LC ₅₀ /fresh water 8.2 Waterway Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Field Chain Concentration Potential: Data not available					12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 10°C and 1 atm: Solid or water solution 12.2 Molecular Weight: 158.04 (MSMA), 174.04 (OSMA) 12.3 Boiling Point at 1 atm: Not determined 12.4 Freezing Point: (MSMA) 240°F = 117°C = 243°F (OSMA) 137°F = 58°C = 328°F 12.5 Critical Temperature: Not determined 12.6 Critical Pressure: Not determined 12.7 Specific Gravity: (MSMA) 1.0 at 20°C (solid) (OSMA) 1.0 at 20°C (solid) 12.8 Liquid Surface Tension: Not determined 12.9 Liquid Water Interfacial Tension: Not determined 12.10 Vapor (Gas) Specific Gravity: Not determined 12.11 Ratio of Specific Heats of Vapor (Gas): Not determined 12.12 Latent Heat of Vaporization: Not determined 12.13 Heat of Combustion: Not determined 12.14 Heat of Decomposition: Not determined 12.15 Heat of Solution: Not determined 12.16 Heat of Polymerization: Not determined 12.17 Heat of Fusion: Data not available 12.18 Melting Point: Data not available 12.19 Solid Vapor Pressure: Data not available				
9. SHIPPING INFORMATION 9.1 Grades of Purity: The same material as (MSMA) contains water impurities. Solid is often shipped as solution in water with concentrations up to about 50% solids. 9.2 Storage Temperature: Ambient 9.3 Short Shelflife: No statement 9.4 Volatility: None					NOTES				

Material Safety Data Sheet

from Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 310
METHYLENE CHLORIDE
(Revision F)

Issued: September 1985
Revised: November 1988

SECTION 1. MATERIAL IDENTIFICATION

27

Material Name: METHYLENE CHLORIDE

Description (Origin/Uses): Used widely in paint removers, as a solvent for plastics, as a degreasing agent, in propellant mixtures for aerosol sprays, and as a blowing agent in foams.

Other Designations: Dichloromethane; Freon 30[®]; Methane Dichloride; Methylene Bichloride; Methylene Dichloride; CH₂Cl₂; CAS No. 0075-09-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.

HMIS				NFPA
H	2	R	1	
F	1	I	3	
R	0	S	3	
PPG*		K	1	

*See sect. 8



SECTION 2. INGREDIENTS AND HAZARDS/EXPOSURE LIMITS

Methylene Chloride, ca 100%

OSHA PEL

8-Hour TWA: 500 ppm

Ceiling: 1000 ppm Acceptable Maximum Peak
above the Ceiling: 2000 ppm for 5 Minutes in
Any 2-Hour Period

ACGIH TLV, 1988-89
TLV-TWA: 50 ppm, 175 mg/m³
(Adopted 1988-89)

Toxicity Data*
Rat, Oral, LD₅₀: 2136 mg/kg
Human, Inhalation, TC₀₁: 500 ppm (8 Hours)

*See NIOSH, RTECS (PA8050000), for additional data with references to irritative, reproductive, mutagenic, and tumorigenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point: 103.55°F (39.75°C) at 76 Torr

Melting Point: -142°F (-96.7°C)

Vapor Density (Air = 1): 2.9

Vapor Pressure: 440 Torr at 77°F (25°C)

Molecular Weight: 84.94 Grams/Mole
Solubility in Water (%): 1% by Weight
Specific Gravity (H₂O = 1): 1.3255 at 68°F (20°C)
% Volatile by Volume: Ca 100

Appearance and Odor: A clear, colorless, volatile liquid; distinctive, penetrating, ethereal odor. The odor will not serve as a useful warning property because concentrations of 100 ppm are not easily perceptible. Most persons can detect this odor at above 300 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*

Autoignition Temperature: 1033°F (556°C)

LEL: 12% w/v

UEL: 19% w/v

Extinguishing Media: *Methylene chloride is not flammable under ordinary conditions. However, flammable vapor-air mixtures can form at approximately 212°F (100°C). Use water spray to cool fire-exposed containers and to flush spills away from exposures. Use extinguishing agents that will put out the surrounding fire. Unusual Fire or Explosion Hazards: Methylene chloride vapor is heavier than air and may collect and concentrate in low-lying, confined spaces. The high vapor pressure of methylene chloride means that when it is spilled, its vapor concentration in air can increase rapidly. If this vapor is heated, an explosion hazard is associated with the vapor-air mixture. Containers of this material may rupture violently if they are involved in fires. Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Stability/Polymerization: Methylene chloride is stable in closed containers during routine operations. Hazardous polymerization cannot occur. Chemical Incompatibilities: Methylene chloride can react dangerously with nitrogen tetroxide, liquid oxygen, potassium, sodium, sodium-potassium alloys, lithium, potassium hydroxide with N-methyl-N-nitroso urea, potassium t-butoxide, and finely powdered aluminum and magnesium. Conditions to Avoid: Avoid all exposure to sources of ignition, heat, and incompatible chemicals. Prolonged exposure to water may cause hydrolysis to highly corrosive hydrochloric acid when the temperature is above 140°F (60°C). In oxygen-enriched atmospheres or when heated (>212°F [100°C]), methylene chloride vapor can be readily ignited. Hazardous Products of Decomposition: Exposure to high temperature (from open flame, hot surfaces, uninsulated steam lines, welding arcs, etc.) can produce toxic and corrosive thermal-oxidative products of decomposition such as hydrogen chloride, carbon monoxide, and even small quantities of phosgene gas, which is extremely poisonous.

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity: Methylene chloride is listed as a suspected human carcinogen by the ACGIH (which classifies it as a group A2 carcinogen). Summary of Risks: Accidental contact of liquid methylene chloride with skin or eyes causes painful irritation and possible burns if not promptly removed. Exposure by way of contaminated gloves, clothing, or paint remover formulations can produce these same irritant effects. Long-term exposure to mild or moderate doses of methylene chloride may cause a delayed (24 to 48 hours) onset of dizziness, headache, mental confusion, slurred speech, double vision, and sleeplessness. Medical recovery can be slow. Overexposure to methylene chloride can cause elevated levels of carboxy hemoglobin in the blood (this same effect results from overexposure to carbon monoxide). Medical Conditions Aggravated by Long-Term Exposure: None reported. Target Organs: Skin, eyes, respiratory system, CNS, liver, kidneys, and blood. Primary Entry: Inhalation, skin contact/absorption. Acute Effects: Headache, giddiness, stupor, irritability, fatigue, tingling in the limbs, and narcosis that is not usually fatal if the exposure is terminated before anesthetic death occurs. Chronic Effects: The ACGIH classification of this material as a suspected human carcinogen implies that cancer is a possible effect of chronic exposure to methylene chloride. FIRST AID: Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with

SECTION 6. HEALTH HAZARD INFORMATION, cont.

flooding amounts of running water for at least 15 minutes. Skin. Rinse the affected area with flooding amounts of water and then wash it with soap and water. Inhalation. Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Note to Attending Physician: Do not administer adrenalin. Ingestion. Unlikely. Should this type of exposure occur, do not induce vomiting because of the danger of aspiration. If spontaneous vomiting should occur, position exposed person's head below his or her trunk to resist aspiration. Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid. Note to Physician: Absorbed methylene chloride is stored in body fat and metabolizes to carbon monoxide. This produced carbon monoxide increases and sustains carboxyhemoglobin levels in the blood, which concomitantly reduces the oxygen-carrying capacity of the blood. NIOSH advises preplacement and annual medical exams that emphasize liver, kidney, eye, skin, CNS, and respiratory system functions and a complete blood count. Simultaneous exposure to tobacco smoke, alcohol, and carbon monoxide, along with heavy manual labor, increases the body burden of a worker as well as the toxic hazards of the methylene chloride. In significant exposures, serum methylene chloride levels are of no clinical importance. Neurologic and hepatic status as well as carboxy hemoglobin should be monitored.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation. Cleanup personnel need protection against this liquid's contact with the skin or eyes as well as inhalation of its vapor. Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways. **Waste Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000 Subpart Z).

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste, NO. U080

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), § 307 (a), and the Resource Conservation and Recovery Act (RCRA), § 3001.

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious neoprene, PVA, or Viton gloves, boots, aprons, and gauntlets, etc., to prevent any skin contact with liquid methylene chloride. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of acetone below the exposure limits cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. Floor or sump ventilation may be necessary. **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants, and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean this material from shoes and equipment. **Other:** Because the health effects of carbon monoxide and methylene chloride are additive (see sect. 6), workplaces should be equipped with automatic sensing equipment that identifies workroom atmospheric levels of both of these materials. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics. Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area. Do not inhale methylene chloride vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store methylene chloride in closed, moisture-proof containers in a cool, dry, well-ventilated area away from sources of ignition, strong oxidizers, caustics, and incompatible chemicals (see sect. 5). Protect containers from physical damage. **Special Handling/Storage:** Prevent moist air from entering storage containers. Provide ventilation at the floor level in storage areas because methylene chloride vapor is denser than air. Installation of a dryer and a safety seal on each tank is recommended. Aluminum is not recommended for use as a storage material; appropriate storage materials include galvanized iron, black iron, or steel. **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Electrically ground and bond all containers and pipelines used in shipping, transferring, reacting, production, and sampling operations to prevent generating static sparks.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Dichloromethane or Methylene Chloride

DOT Hazard Class: ORM-A

ID No. UN1593

DOT Packaging Requirements: 49 CFR 173.605

DOT Packaging Exceptions: 49 CFR 173.505

IMO Shipping Name: Dichloromethane

IMO Hazard Class: 6.1

IMO Label: Saint Andrew's Cross (X)*

IMDG Packaging Group: III

*Harmful-Slow away from Foodstuffs.

References: 1, 26, 38, 84-94, 100, 116, 117, 120, 122.

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Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

MPT

JUNE 1925

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP.

No. 7

NITRIC ACID
(Revision C)

Issued: October 1980
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: NITRIC ACID

Description (Origin/Uses): Used to dissolve noble metals, for etching and cleaning metals, to make organic nitrates and nitrocompounds, to destroy residues of organic matter, and in explosives.

Other Designations: Red Fuming Nitric Acid; HNO_3 ; CAS No. 7697-37-2

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref. 73) for a list of suppliers.



NFPA

HMS

H 3

F 0

R 1

PPG*

*See sect. 8

R 1

I 4

S 4

K 0

SECTION 2. INGREDIENTS AND HAZARDS

Nitric Acid, CAS No. 7697-37-2

*Contact your supplier to determine the percent by weight of nitric acid in the purchased product. Water is the other component of the product.
**See NIOSH, RTECS (QU5775000, QU5900000), for additional data with references to reproductive effects.

OSHA PEL
8-Hr TWA: 2 ppm, 5 mg/m³

ACGIH TLVs, 1987-88
TLV-TWA: 2 ppm, 5 mg/m³
TLV-STEL: 4 ppm, 10 mg/m³

Toxicity Data**
Mouse, Inhalation, LC_{50} : 67 ppm/4 Hrs

SECTION 3. PHYSICAL DATA

Boiling Point: Ca 251°F (122°C)*
Specific Gravity ($\text{H}_2\text{O} = 1$): 1.4*
pH: Very Acidic

Water Solubility (%): Complete
Molecular Weight: 63 Grams/Mole
Melting Point: Ca -30°F (-34°C)*

Appearance and Odor: A water white to slightly yellow liquid that darkens to a brownish color on aging and exposure to light; characteristic nitrogen dioxide (NO_2) odor.

*These properties are for the approximately 68%-by-weight nitric acid that is commercially available.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
.	.	% by Volume	.	.

Extinguishing Media: *Nitric acid does not burn. Use extinguishing agents that will put out the surrounding fire. Use a water spray to dilute nitric acid during fires and to absorb liberated oxides of nitrogen.

Unusual Fire or Explosion Hazards: Although nitric acid does not burn, it is a strong oxidizing agent that can react with combustible materials to cause fires. Also, it can react with metals to liberate extremely flammable hydrogen gas. If this happens, direct fire-fighting procedures at this evolved hydrogen gas.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Choose protective equipment carefully (see sect. 5, Conditions to Avoid).

SECTION 5. REACTIVITY DATA

Nitric acid is stable in closed containers at room temperature under normal storage and handling conditions. It cannot undergo hazardous polymerization.

Chemical Incompatibilities: Nitric acid reacts explosively with metallic powders, carbides, hydrogen sulfide, and turpentine. Contact with organic materials such as wood, paper, sawdust, or alcohol, etc., may cause fires. Combustible materials can sustain an increased flammability after being exposed to nitric acid even if they do not immediately catch fire.

Conditions to Avoid: Avoid any contact with incompatible chemicals. Because it is so reactive, always establish another material's compatibility with nitric acid before mixing the two materials. This applies to the selection of safety and handling equipment, because nitric acid can attack some forms of coatings, plastics, and rubber.

Hazardous Products of Decomposition: Various nitrogen oxides, including nitric oxide (NO), nitrogen dioxide (NO_2), nitrous oxide (N_2O), as well as nitric acid mist or vapor, can be produced by the decomposition reactions that can affect the nitric acid during fires.

SECTION 6. HEALTH HAZARD INFORMATION

Nitric acid is not listed as a carcinogen by the NTP, IARC, or OSHA.

Summary of Risks: This material is corrosive to any body tissue it contacts. Dental erosion is also reported.

Medical Conditions Aggravated by Long-Term Exposure: None reported. **Target Organs:** Skin, eyes, mucous membranes of the respiratory tract, teeth. **Primary Entry:** Inhalation, skin contact. **Acute Effects:** Irritation and/or corrosive burns of skin, eyes, and upper respiratory tract (URT), delayed pulmonary edema, pneumonitis, bronchitis, and dental erosion. **Chronic Effects:** None reported.

FIRST AID: **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Treat for eye burns. **Skin.** Immediately wash the affected area with soap and water. Watch for chemical skin burns and treat them accordingly. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. If the exposure is severe, hospitalization with careful monitoring by trained medical personnel to detect the delayed onset of severe pulmonary edema (lungs filled with fluid) is recommended for at least 72 hours. **Ingestion.** Call a poison control center. Never give anything by mouth to someone who is unconscious or convulsing. Do not induce vomiting. If the exposed person is responsive, give him or her one or two glasses of milk or water to drink as quickly as possible after exposure.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. **NOTE TO PHYSICIAN:** Wash affected skin areas with a 5% solution of sodium bicarbonate (NaHCO_3). If ingested, the risk versus the benefit of the passage of a naso-gastric tube is debatable. Activated charcoal is of no value. Do not give the exposed person bicarbonate to neutralize the material.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately in case contact with metals should produce highly flammable hydrogen gas. Cleanup personnel need protection against contact with and inhalation of nitric acid (see sect. 8). Contain large spills and collect waste. Use water sprays to direct nitric acid away from incompatible chemicals (see sect. 5). Neutralize the spilled nitric acid with soda ash or sodium bicarbonate. Use an absorbent such as sand, earth, or vermiculite on the resulting slurry and place the neutralized nitric acid material into containers suitable for eventual disposal, reclamation, or destruction.

Waste Disposal: Consider reclamation, recycling, or destruction rather than disposal in a landfill. Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations (40 CFR 302.4)

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per Clean Water Act (CWA), Section 311 (b) (4)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing of nitric acid solution is possible, wear a full face shield as a supplementary protective measure. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133).

Respirator: Consult the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref. 88) for general recommendations on proper respiratory procedures. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine use (leaks or cleaning reactor vessels and storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent skin contact with nitric acid. Choose protective equipment carefully (see sect. 5, Conditions to Avoid).

Ventilation: Install and operate both general and local exhaust-ventilation systems powerful enough to maintain airborne concentrations of nitric acid below the OSHA PEL standard cited in section 2. Construct exhaust ducts and systems with material such as fiberglass, which resists attack by nitric acid. **Safety Stations:** Make emergency eyewash stations, washing facilities, and safety/quickdrench showers available in work areas. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean nitric acid from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area. Provide preplacement and annual medical exams with emphasis on skin irritation to workers who are regularly exposed to nitric acid. Workers must receive training before handling this material in the workplace; even experienced workers should undergo refresher training periodically.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store nitric acid in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5). Consider outside, isolated, or detached storage. Protect containers from direct sunlight.

Special Handling/Storage: Build all storage facilities of nonflammable materials that are resistant to chemical attack by nitric acid. Protect containers from physical damage. Preplan for routine use and emergency response.

Engineering Controls: Proper ventilation is essential in bulk storage areas; consider installing an automatic monitoring system to detect hazardous levels of nitrogen oxides that can develop from this material.

Comments: Separate nitric acid from hydrazine, diethylenetriamine, fluorides, and all other corrosives except sulfuric acid and sulfur trioxide when shipping or transferring it.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: (I) Nitric Acid, Fuming or (II) Nitric Acid, Over 40% or (III) Nitric Acid, 40% or Less

DOT Label: (I) Oxidizer and Poison or (II) Oxidizer and Corrosive or (III) Corrosive

DOT Hazard Class: (I) and (II) Oxidizer or (III) Corrosive Material

DOT ID Nos. (I) UN2032; (II) UN2031; (III) NA1760

IMO Class: 8 (All Types of Nitric Acid)

IMO Label: (I) Corrosive, Oxidizer, Poison; or (II) and (III) Corrosive

References: 1, 2, 26, 38, 84-94, 100, 112, 113, 114.

Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corp. extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

NITROGEN TETROXIDE

NOX

Common Synonyms Nitrogen dioxide Brown fumes Red fume of nitrogen Fumes of nitrogen Nitrogen tetroxide	Liquid compressed gas Red-brown Dark and reacts with water. Fumes brown vapor is produced.	Ships, unclassified UNCLASSIFIED				
AVOID CONTACT WITH LIQUID AND VAPOR Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (breathing device). Skin discharge 4 minutes. Evaluate area in case of large discharge. Notify local health and radiation control agencies.						
Fire	Not flammable. May react in air and oxidize on contact with combustibles. POISONOUS GASES ARE PRODUCED IN FIRE AND WHEN HEATED. Wear goggles, self-contained breathing apparatus, and rubber overclothing (breathing device). Skin discharge 4 minutes. Evaluate area in case of large discharge. Notify local health and radiation control agencies.					
Exposure	CALL FOR MEDICAL AID. VAPOR POISONOUS IF INHALED. Irritates to eyes. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Not skin irritant and toxic. POISONOUS IF SWALLOWED. Remove contaminated clothing and shoes. Flush clothing inside with plenty of water. If in EYES, keep eyes open and flush with plenty of water. If SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.					
Water Pollution	HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS. May be dangerous if it enters water drains. Notify local health and waste officials. Notify authorities of nearby water drains.					
<table><tr><td>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Notify transportation, or department, water environmental agencies Notify local health and waste officials</td><td>2. LABEL 2.1 Category: Poison gas; Oxidizer 2.2 Class: 2 and 5</td></tr><tr><td>3. CHEMICAL DESIGNATIONS 3.1 DOT Commodity Class: Not listed 3.2 Formula: N_2O_4 3.3 DOT/ADR Designation: 21057 3.4 DOT ID No.: 1857 3.5 CAS Registry No.: 10102-44-2</td><td>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State: Gas (colorless liquid) 4.2 Color: Red-brown in various concentrations various colors about 14°F 4.3 Odor: Pungent, acid, easily irritating</td></tr></table>			1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Notify transportation, or department, water environmental agencies Notify local health and waste officials	2. LABEL 2.1 Category: Poison gas; Oxidizer 2.2 Class: 2 and 5	3. CHEMICAL DESIGNATIONS 3.1 DOT Commodity Class: Not listed 3.2 Formula: N_2O_4 3.3 DOT/ADR Designation: 21057 3.4 DOT ID No.: 1857 3.5 CAS Registry No.: 10102-44-2	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State: Gas (colorless liquid) 4.2 Color: Red-brown in various concentrations various colors about 14°F 4.3 Odor: Pungent, acid, easily irritating
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5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Rubber gloves, safety goggles and face shield, protective clothing, and gas cylinder regulator or self-contained breathing apparatus. 5.2 Symptoms Following Exposure: Very concentrated fumes produce coughing, choking, headache, nausea, pain in chest and abdominal distress, the symptoms appear at time of exposure. After symptomatic period of 1-72 hours, pulmonary edema gradually develops, causing cough, respiratory distress, difficulty in breathing, rapid respiration, mental confusion, delirium, shock and, and death. Skin irritation occurs with gas discharge in large, uncontrolled areas and death by asphyxiation can result, usually within a few hours after onset of respiratory distress. 5.3 Treatment of Exposed POPULATIONS: Remove victim to fresh air and have him breathe as easily as possible; call a doctor; arrange complete rest for 24-48 hours; keep victim, give oxygen if breathing stops; physician may administer morphine (10 mg.) EYES AND SKIN: Wash with water for at least 10 min. 5.4 Threshold Limit Value: 5 ppm 5.5 Short Term Exposure Limit: 25 ppm for 5 min. 5.6 Toxicity by Ingestion: Data not available 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Skin) Irritant Characteristics: Vapors cause severe irritation of skin and chest and can cause eye and lung injury. They should be avoided even at low concentrations. 5.9 Liquid or Solid Irritant Characteristics: Severe skin irritant. Causes severe and third-degree burns on short contact and is very corrosive to the eyes. 5.10 Oral Toxicity: 5 ppm 5.11 LD ₅₀ Value: 50 ppm						

6. FIRE HAZARDS 6.1 Flash Point: Not determined 6.2 Flammable Limits in air: Not determined 6.3 Fire Extinguishing Agents: Dry fire of gas 6.4 Fire Extinguishing Agents that do not work: Not determined 6.5 Special Hazards of Combustion: Products: Products: toxic gas when heated. 6.6 Behavior in Fire: Does not burn, but supports combustion of combustible materials such as wood, may cause fire or explode on contact with other materials. 6.7 Ignition Temperature: Not determined 6.8 Self-Heating: Data not available 6.9 Burning Rate: Not determined 6.10 Autoxidation: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-4-J-O																																				
7. CHEMICAL REACTIVITY 7.1 Reactivity with Water: Chlorine is toxic and reacts with water. Nitrogen dioxide reacts with air to form more nitrogen dioxide. 7.2 Reactivity with Common Materials: Very corrosive to metals when wet. Reacts vigorously with combustible materials such as wood. 7.3 Stability During Transport: Stable 7.4 Incompatibility Agents: Not listed 7.5 Incompatibility Agents: Not listed 7.6 Polymerization: Not determined 7.7 Polymerization: Not determined 7.8 Polymerization: Not determined 7.9 Polymerization: Not determined 7.10 Polymerization: Not determined	11. HAZARD CLASSIFICATIONS 11.1 State of Federal Regulations: Poison A 11.2 Self-Heating Rating for Bulk Water Transportation: <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>0</td> </tr> <tr> <td>Health</td> <td>4</td> </tr> <tr> <td>Vapor irritant</td> <td>4</td> </tr> <tr> <td>Liquid or Solid irritant</td> <td>4</td> </tr> <tr> <td>Poison</td> <td>4</td> </tr> <tr> <td>Water Pollution</td> <td>3</td> </tr> <tr> <td>Human Toxicity</td> <td>3</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>3</td> </tr> <tr> <td>Acute Effect</td> <td>4</td> </tr> <tr> <td>Reactivity</td> <td>2</td> </tr> <tr> <td>Other Chemical</td> <td>0</td> </tr> <tr> <td>Water</td> <td>0</td> </tr> <tr> <td>Sol. Reaction</td> <td>0</td> </tr> </tbody> </table> 11.3 GHS Hazard Classification: <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (GHS)</td> <td>3</td> </tr> <tr> <td>Flammability (GHS)</td> <td>0</td> </tr> <tr> <td>Reactivity (GHS)</td> <td>0</td> </tr> </tbody> </table>	Category	Rating	Fire	0	Health	4	Vapor irritant	4	Liquid or Solid irritant	4	Poison	4	Water Pollution	3	Human Toxicity	3	Aquatic Toxicity	3	Acute Effect	4	Reactivity	2	Other Chemical	0	Water	0	Sol. Reaction	0	Category	Classification	Health Hazard (GHS)	3	Flammability (GHS)	0	Reactivity (GHS)	0
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Health Hazard (GHS)	3																																				
Flammability (GHS)	0																																				
Reactivity (GHS)	0																																				
8. WATER POLLUTION 8.1 Aquatic Toxicity: 72 percent to immediate fish/TL/Toxic water 250-1000 ppm/48 hr/fish/TL/Toxic water 8.2 Waterborne Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 60°F and 1 atm: Gas 12.2 Molecular Weight: 92.02 12.3 Boiling Point at 1 atm: 70.1°F = 21.2°C = 294°K 12.4 Freezing Point: 11.3°F = -11.5°C = 267°K 12.5 Critical Temperature: 517.9°F = 265.5°C = 491.4°K 12.6 Critical Pressure: 1470 atm = 149 atm = 10.1 MPa 12.7 Specific Gravity: 1.45 at 20°C (liquid) 12.8 Liquid Surface Tension: Not determined 12.9 Liquid Water Insolubility: Not determined 12.10 Vapor (Skin) Specific Gravity: 2.2 12.11 Ratio of Specific Heats of Vapor (Skin): (not) 1.20 12.12 Latent Heat of Vaporization: 170 Btu/lb = 69.1 cal/g = 4.10 x 10 ⁴ J/kg 12.13 Heat of Combustion: Not determined 12.14 Heat of Decomposition: Not determined 12.15 Heat of Solution: Data not available 12.16 Heat of Polymerization: Not determined 12.17 Latent Heat: Data not available 12.18 Solid Vapor Pressure: 20 atm																																				
9. SHIPPING INFORMATION 9.1 Grades of Purity: Data not available 9.2 Storage Temperature: Ambient, Storage and transport conditions shall be approved with manufacturer's verification system. 9.3 Short Atmospheric: No requirement 9.4 Vapour Pressure: Data not available	13. FIRE HAZARDS (Continued) 13.1 Self-Heating: Air to Fuel Ratio: Data not available 13.2 Flame Temperature: Data not available																																				

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855



No. 205

POTASSIUM NITRATE

Issued: January 1987

SECTION 1. MATERIAL IDENTIFICATION

22

MATERIAL NAME: POTASSIUM NITRATE

DESCRIPTION/USES: Used in pyrotechnics; explosives; matches; as a specialty fertilizer; reagent; to modify burning properties of tobacco; in glass manufacture; tempering steel; curing foods; as an oxidizer in solid rocket propellants.

OTHER DESIGNATIONS: Nitric Acid, Potassium Salt; Niter; Saltpeter; KNO₃; CAS #7757-79-1

MANUFACTURER/SUPPLIER: Available from several suppliers, including: Aldrich Chemical Co., Inc., PO Box 355, Milwaukee, WI 53201; Telephone: (414) 273-3850



HMIS

Nonfire

Fire

H 1

F 0

R 1

PPE*

*See Sect. 8

R 1

I -

S 2

K 0

SECTION 2. INGREDIENTS AND HAZARDS

%

HAZARD DATA

Potassium Nitrate, CAS #7757-79-1

>99%

ACGIH TLV:
None Established

OSHA PEL:
None Established

Oral, Rat,
LD₅₀: 3750 mg/kg

Oral, Rabbit,
LD₅₀: 1901 mg/kg

SECTION 3. PHYSICAL DATA

Melting Point ... 633°F (334°C)
Boiling Point ... 400°C (Decomposes)
Specific Gravity @ 16°C ... 2.11
Vapor Pressure @ 20°C ... Negligible
% Volatiles ... 0
Evaporation Rate ... Not Found

Solubility in Water, at 0°C ... 133 g/100 cc
at 100°C ... 247 g/100 cc
pH of 5% Solution, at 25°C ... 4.5-7.0
Molecular Weight ... 101.1

Appearance and odor: White crystalline powder or granules. No odor.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
Not Found	Not Found	Not Found	--	--

Potassium nitrate is not combustible. However, it is a strong oxidizer and can initiate and intensify combustion of flammable materials.

EXTINGUISHING AGENTS: Flood fires involving this material with water. Keep fire-exposed containers cool with water spray. Remove containers from the fire area if it can be done safely.

UNUSUAL FIRE/EXPLOSION HAZARDS: At high temperatures this material can fuse or melt; application of water when large quantities are involved can result in extensive scattering of molten material.

SPECIAL FIRE-FIGHTING PROCEDURES: Toxic fumes/gases can be evolved in a fire situation. Fire fighters should use self-contained breathing apparatus and wear full protective gear.

SECTION 5. REACTIVITY DATA

Potassium nitrate is stable at room temperature. It does not polymerize.

Violent reactions (including fire and explosion) may occur on its contact with organic materials, combustible materials, and reducing agents. Specific incompatibles under various conditions include aluminum, titanium, antimony, germanium, zinc, zirconium (and other metals), calcium disilicide, chromium nitride, metal sulfides, boron, carbon, sulfur, phosphorus, phosphides, sodium phosphinate, sodium thiosulfate, citric acid, tin chloride, sodium acetate, and thorium carbide.

Potassium nitrate decomposes at approximately 752°F (400°C) with the evolution of oxygen and oxides of nitrogen (toxic).

SECTION 6. HEALTH HAZARD INFORMATION

Potassium nitrate has not been identified as a known or suspected carcinogen by the NTP, IARC, or OSHA. This material can enter the body if it is inhaled or swallowed.

EFFECTS OF OVEREXPOSURE: Inhalation of excessive concentrations may be irritating to the nose, throat, and respiratory tract. Prolonged exposure may cause anemia, methemoglobinemia (the presence of methemoglobin, a soluble brown crystalline blood pigment that differs from hemoglobin in that it contains ferric iron and is unable to combine reversibly with molecular oxygen), and kidney injury (nephritis). Ingestion can cause severe gastrointestinal distress with abdominal pain, nausea, vomiting, and diarrhea. Eye contact may cause irritation.

FIRST AID: EYE CONTACT: Flush eyes, including under the eyelids, with a gentle flow of running water. Get medical help.*
SKIN CONTACT: Wash affected area with mild soap and water. If irritation persists, prevent further contact and get medical help.*
INHALATION: Remove victim from exposure. Get medical help if irritation or discomfort persists.*
INGESTION: Give victim a large quantity of water to drink. Induce vomiting and get prompt medical help.*
NOTE: Never give anything by mouth or induce vomiting if the victim is unconscious.
* **GET MEDICAL ASSISTANCE** - In plant, community, paramedic. Get medical help for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Ventilate the potassium nitrate spill area. Prevent contact of spilled material with combustible and incompatible materials. Cleanup personnel should wear personal protective equipment as necessary to prevent skin/eye contact and dust inhalation. Carefully scoop spilled material into a suitable container for reclamation or disposal. Avoid generating dust during cleanup. Absorb small solution spills on inert (noncombustible) material such as dry sand or earth.
Disposal: Potassium nitrate requires disposal as a hazardous waste. Reclaim material when possible. Contact your supplier or a licensed chemical waste disposal contractor for treatment and disposal instructions. Follow all applicable Federal, state, and local regulations.

Reportable Spill Quantity: Not listed in 40 CFR 117.3, "Reportable Quantities of Hazardous Substances."
EPA Hazardous Waste Number: D001 (Ignitable, 40 CFR 261.21)

SECTION 8. SPECIAL PROTECTION INFORMATION

Use local exhaust ventilation to control airborne levels where potassium nitrate dust, mist, or fumes are generated.

Use an appropriate NIOSH-approved respirator for protection against potassium nitrate dust/mist where airborne levels are excessive. Respirator usage must be in accordance with OSHA requirements (29 CFR 1910.134).

Wear protective clothing (aprons, coveralls, etc.) where the possibility of skin or clothing contamination exist. Wear rubber gloves and safety goggles when handling this material.

Eyewash stations and washing facilities should be readily accessible to workers handling this material.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Particles may adhere to contact lenses and cause corneal damage.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store potassium nitrate in closed containers in a cool, dry location on a noncombustible surface. Store it away from flammable and combustible materials, reducing agents, and other incompatible materials (see sect. 5). Protect containers from physical damage.

Practice good housekeeping. Clean up spills promptly. Use procedures and techniques that minimize dust generation. Practice good personal hygiene. Wash thoroughly after handling this material and before eating, drinking, and smoking. Do not eat, drink, or smoke in the work area. Remove contaminated clothing promptly. Launder it before wearing it again. Do not take this material out of your work area or to your home on your clothing or equipment.

DOT Hazard Classification: Oxidizer (49 CFR 172.101) **DOT ID No.** UN1486 **DOT Label:** Oxidizer

Data Source(s) Code: 4, 5, 6, 9, 25, 49, 58, 77, 82, CV

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Approvals *DO Approved*

Indust. Hygiene/Safety *8/21 4/87*

Medical Review *8/21 4/87*

Material Safety Data Sheet
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No. 317
TOLUENE
 (Revision D)

Issued: August 1979
 Revised: April 1986

SECTION 1. MATERIAL IDENTIFICATION 20

MATERIAL NAME: TOLUENE

OTHER DESIGNATIONS: Methyl Benzene, Methyl Benzol, Phenylmethane, Toluol, C₇H₈, CAS #0108-88-3

MANUFACTURER/SUPPLIER: Available from many suppliers, including:
 Allied Corp., PO Box 2064R, Morristown, NJ 07960; Telephone: (201) 455-4400
 Ashland Chemical Co., Industrial Chemicals & Solvents Div., PO Box 2219,
 Columbus, OH; Telephone: (614) 889-3844

HMIS

H: 2

F: 3

R: 0

PPE*

*See sect. 8



R 1
 I 3
 S 2
 K 4

SECTION 2. INGREDIENTS AND HAZARDS

Toluene



- * Current (1985-86) ACGIH TLV. The OSHA PEL is 200 ppm with an acceptable ceiling concentration of 300 ppm and an acceptable maximum peak of 500 ppm/10 minutes.
- ** Skin designation indicates that toluene can be absorbed through intact skin and contribute to overall exposure.
- *** Affects the mind.

HAZARD DATA

ca 100

8-hr TLV: 100 ppm, or
 375 mg/m³* (Skin)**

Min. Inhalation, TCLo:
 100 ppm: Psychotropic***

Rat, Oral, LD₅₀: 5000 mg/kg

Rat, Inhalation, LCLo:

4000 ppm/4 hrs.

Rabbit, Skin, LD₅₀: 14 gm/kg

Human, Eye: 300 ppm

SECTION 3. PHYSICAL DATA

Boiling Point ... 231°F (111°C)

Vapor Pressure @ 20°C, mm Hg ... 22

Water Solubility @ 20°C, wt. % ... 0.05

Vapor Density (Air = 1) ... 3.14

Evaporation Rate (BuAc = 1) ... 2.24

Specific Gravity (H₂O = 1) ... 0.866

Melting Point ... -139°F (-95°C)

Percent Volatile by Volume ... ca 100

Molecular Weight ... 92.15

Appearance and odor: Clear, colorless liquid with a characteristic aromatic odor. The odor is detectable to most individuals in the range of 10 to 15 ppm. Because olfactory fatigue occurs rapidly upon exposure to toluene, odor is not a good warning property.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
40°F (4°C) CC	896°F (480°C)	% by Volume	1.27	7.1

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, alcohol foam. Do not use a solid stream of water because the stream will scatter and spread the fire. Use water spray to cool tanks/containers that are exposed to fire and to disperse vapors.

UNUSUAL FIRE/EXPLOSION HAZARDS: This OSHA class IB flammable liquid is a dangerous fire hazard. It is a moderate fire hazard when exposed to oxidizers, heat, sparks, or open flame. Vapors are heavier than air and may travel a considerable distance to an ignition source and flash back.

SPECIAL FIRE-FIGHTING PROCEDURES: Fire fighters should wear self-contained breathing apparatus with full facepiece operated in a positive-pressure mode when fighting fires involving toluene.

SECTION 5. REACTIVITY DATA

CHEMICAL INCOMPATIBILITIES: Toluene is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. This material is incompatible with strong oxidizing agents, dinitrogen tetroxide, silver perchlorate, tetranitromethane, and uranium hexafluoride. Contact with these materials may cause fire or explosion. Nitric acid and toluene, especially in the presence of sulfuric acid, will produce nitrated compounds that are dangerously explosive.

CONDITIONS TO AVOID: Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition. Toluene will attack some forms of plastics, rubber, and coatings. Thermal decomposition or burning produces carbon dioxide and/or carbon monoxide.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Toluene is not considered a carcinogen by the NTP, IARC, or OSHA. **SUMMARY OF RISKS:** Vapors of toluene may cause irritation of the eyes, nose, upper respiratory tract, and skin. Exposure to 200 ppm for 8 hours causes mild fatigue, weakness, confusion, lacrimation (tearing) and paresthesia (a sensation of prickling, tingling, or creeping on the skin that has no objective cause). Exposure to higher concentrations may cause headache, nausea, dizziness, dilated pupils, and euphoria, and, in severe cases, may cause unconsciousness and death. The liquid is irritating to the eyes and skin. Contact with the eyes may cause transient corneal damage, conjunctival irritation, and burns if not promptly removed. Repeated and/or prolonged contact with the skin may cause drying and cracking. It may be absorbed through the skin in toxic amounts. Ingestion causes irritation of the gastrointestinal tract and may cause effects resembling those from inhalation of the vapor. Chronic overexposure to toluene may cause reversible kidney and liver injury. **FIRST AID: EYE CONTACT:** Immediately flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention if irritation persists. * **SKIN CONTACT:** Immediately flush skin (for at least 15 minutes) while removing contaminated shoes and clothing. Wash exposed area with soap and water. Get medical attention if irritation persists or if a large area has been exposed. * **INHALATION:** Remove victim to fresh air. Restore and/or support breathing as required. Keep victim warm and quiet. Get medical help. * **INGESTION:** Give victim 1 to 2 glasses of water or milk. Contact a poison control center. Do not induce vomiting unless directed to do so. Transport victim to a medical facility. Never give anything by mouth to a person who is unconscious or convulsing. * **GET MEDICAL ASSISTANCE** - In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid, if indicated.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK: Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Limit access to spill area to necessary personnel only. Remove leaking containers to safe place if feasible. Cleanup personnel need protection against contact with liquid and inhalation of vapor (see sect. 8). **WASTE DISPOSAL:** Absorb small spills with paper towel or vermiculite. Contain large spills and collect if feasible, or absorb with vermiculite or sand. Place waste solvent or absorbent into closed containers for disposal using nonsparking tools. Liquid can be flushed with water to an open holding area for handling. Do not flush to sewer, watershed, or waterway. **COMMENTS:** Place in suitable container for disposal by a licensed contractor or burn in an approved incinerator. Consider reclaiming by distillation. Contaminated absorbent can be buried in a sanitary landfill. Follow all Federal, state, and local regulations. TLV 96: 100-10 ppm. Toluene is designated as a hazardous waste by the EPA. The EPA (RCRA) HW No. is U220 (40 CFR 261). The reportable quantity (RQ) is 1000 lbs/454 kg (40 CFR 117).

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Ventilation fans and other electrical service must be nonsparking and have an explosion-proof design. Exhaust hoods should have a face velocity of at least 100 fpm (linear feet per minute) and be designed to capture heavy vapor. For emergency or nonroutine exposures where the TLV may be exceeded, use an organic chemical cartridge respirator if concentration is less than 200 ppm and an approved canister gas mask or self-contained breathing apparatus with full facepiece if concentration is greater than 200 ppm. Safety glasses or splash goggles should be worn in all work areas. Neoprene gloves, apron, face shield, boots, and other appropriate protective clothing and equipment should be available and worn as necessary to prevent skin and eye contact. Remove contaminated clothing immediately and do not wear it until it has been properly laundered.

Eyewash stations and safety showers should be readily available in use and handling areas.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION: Store in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, or open flame. Storage areas must meet OSHA requirements for class IB flammable liquids. Use metal safety cans for handling small amounts. Protect containers from physical damage. Use only with adequate ventilation. Avoid contact with eyes, skin, or clothing. Do not inhale or ingest. Use caution when handling this compound because it can be absorbed through intact skin in toxic amounts. **SPECIAL HANDLING/STORAGE:** Ground and bond metal containers and equipment to prevent static sparks when making transfers. Do not smoke in use or storage areas. Use nonsparking tools. **ENGINEERING CONTROLS:** Preplacement and periodic medical exams emphasizing the liver, kidneys, nervous system, lungs, heart, and blood should be provided. Workers exposed to concentrations greater than the action level (50 ppm) should be examined at least once a year. Use of alcohol can aggravate the toxic effects of toluene.

COMMENTS: Emptied containers contain product residues. Handle accordingly!

Toluene is designated as a hazardous substance by the EPA (40 CFR 116). DOT Classification: Flammable liquid. UN1294. Data Source(s) Code: 1-9, 12, 16, 20, 21, 24, 26, 34, 81, 82. CR

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Carson Publishing Corp. extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

Approvals *JO. Rencisco, 11/86.*

Indust. Hygiene/Safety *JW 10-86*

Medical Review *[Signature] Oct 86*

TXP

JUNE 1985

Material Safety Data Sheet

From Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855



GENIUM PUBLISHING CORP.

No. 318

XYLENE (Mixed Isomers)
(Revision D)
Issued: November 1980
Revised: August 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name: XYLENE (Mixed Isomers)

Description (Origin/Uses): Used as a raw material for the production of benzoic acid, phthalic anhydride, isophthalic and terephthalic acids and their dimethyl esters in the manufacture of polyester fibers; in sterilizing catgut; with Canadian balsam as oil-immersion in microscopy; and as a cleaning agent in microscopic techniques.

Other Designations: Dimethylbenzene; Xylol; C_6H_4 ; CAS No. 1330-20-7

Manufacturer: Contact your supplier or distributor. Consult the latest edition of the *Chemicalweek*

Buyers' Guide (Genium ref. 73) for a list of suppliers.

Comments: Although there are three different isomers of xylene (*ortho*, *meta*, and *para*), the health and physical hazards of all three isomers are very similar. This MSDS is written for a xylene mixture of all three isomers, which is usually commercial xylene.

HMIS

H 2

F 3

R 0

PPG*

*Sec sect. 8

NFPA

R 1

I 3

S 2

K 3

SECTION 2. INGREDIENTS AND HAZARDS

Xylene (Mixed Isomers), CAS No. 1330-20-7*

*o-Xylene, CAS No. 0095-47-6

m-Xylene, CAS No. 0108-38-3

p-Xylene, CAS No. 0106-42-3

**Check with your supplier to determine if there are additions, contaminants, or impurities (such as benzene) that are present in reportable quantities per 29 CFR 1910.

***Immediately dangerous to life and health.

**** See NIOSH, *ATECS* (No. ZE2100000), for additional data with references to reproductive, irritative, and mutagenic effects.

%

**

EXPOSURE LIMITS

IDLH*** Level: 1000 ppm

OSHA PEL

8-Hr TWA: 100 ppm, 435 mg/m³

ACGIH TLVs, 1987-88

TLV-TWA: 100 ppm, 435 mg/m³

TLV-STEL: 150 ppm, 655 mg/m³

Toxicity Data****

Human, Inhalation, TC₀₁: 200 ppm

Man, Inhalation, LC₅₀: 10000 ppm/6 Hrs

Rat, Oral, LD₅₀: 4300 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point: 215°F to 293°F (135°C to 145°C)*

Melting Point: -33°F (-25°C)

Evaporation Rate: 0.6 Relative to BuAc = 1

Specific Gravity(H_2O = 1): 0.86

Water Solubility (%): Insoluble

Molecular Weight: 106 Grams/Mole

% Volatile by Volume: Ca 100

Vapor Pressure: 7 to 9 Torrs at 68°F (20°C)

Vapor Density (Air = 1): 3.7

Appearance and Odor: A clear liquid; aromatic hydrocarbon odor.

*Materials with wider and narrower boiling ranges are commercially available.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
81°F to 90°F (27°C to 32°C)	867°F (464°C)	% by Volume	1%	7%

Extinguishing Media: Use foam, dry chemical, or carbon dioxide. Use water sprays to reduce the rate of burning and to cool containers.

Unusual Fire or Explosion Hazards: Xylene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flashback.

Special Fire-fighting Procedures: Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Xylene is stable in closed containers during routine operations. It does not undergo hazardous polymerization.

Chemical Incompatibilities: This material may react dangerously with strong oxidizers.

Conditions to Avoid: Avoid any exposure to sources of ignition and to strong oxidizers.

Hazardous Products of Decomposition: Carbon monoxide (CO) may be evolved during xylene fires.

SECTION 6. HEALTH HAZARD INFORMATION

Xylene is not listed as a carcinogen by the IARC, NTP, or OSHA.

Summary of Risks: Liquid xylene is a skin irritant and causes erythema, dryness, and defatting; prolonged contact may cause blistering. Inhaling xylene can depress the central nervous system (CNS), and ingesting it can result in gastrointestinal disturbance; and possibly hematemesis (vomiting blood). Effects on the eyes, kidneys, liver, lungs, and the CNS are also reported. **Medical Conditions Aggravated by Long-Term Exposure:** Problems with eyes, skin, central nervous system, kidneys, and liver may be worsened by exposure to xylene. **Target Organs:** CNS, eyes, gastrointestinal tract, blood, liver, kidneys, skin. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects:** Dizziness; excitement; drowsiness; incoordination; staggering gait; irritation of eyes, nose, and throat; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; and dermatitis. **Chronic Effects:** Reversible eye damage, headache, loss of appetite, nervousness, pale skin, and skin rash.

FIRST AID: **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin.** Immediately wash the affected area with soap and water. **Inhalation.** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have a trained person administer oxygen. **Ingestion.** Never give anything by mouth to someone who is unconscious or convulsing. Vomiting may occur spontaneously, but do not induce it. If vomiting should occur, keep exposed person's head below his or her hips to prevent aspiration (breathing the liquid xylene into the lungs). Severe hemorrhagic pneumonitis with grave, possibly fatal, pulmonary injury can occur from aspirating very small quantities of xylene.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. If exposure is severe, hospitalization for at least 72 hours with careful monitoring for delayed onset of pulmonary edema is recommended.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak: Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately. Cleanup personnel need protection against contact with and inhalation of xylene vapor (see sect. 8). Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite. Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.

Waste Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations.

OSHA Designations

Air Contaminant (29 CFR 1910.1000 Subpart Z)

EPA Designations (40 CFR 302.4)

RCRA Hazardous Waste, No. U239

CERCLA Hazardous Substance, Reportable Quantity: 1000 lbs (454 kg), per the Clean Water Act (CWA), section 311 (b) (9)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles: Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield as a supplementary protective measure. Follow OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910.134). For emergency or nonroutine use (leaks or cleaning reactor vessels and storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode. **Warning:** Air-purifying respirators will not protect workers in oxygen-deficient atmospheres. **Other:** Wear impervious gloves, boots, aprons, gauntlets, etc., as required by the specifics of the work operation to prevent prolonged or repeated skin contact with xylene. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of xylene below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of xylene into general work areas by eliminating it at its source. Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations:** Make eyewash stations, safety/quick-drench showers, and washing facilities available in areas of use and handling. **Contaminated Equipment:** Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Do not wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again; clean xylene from shoes and equipment. **Comments:** Practice good personal hygiene; always wash thoroughly after using this material. Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking. Do not eat, drink, or smoke in any work area. Do not inhale xylene vapor.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation: Store xylene in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage.

Special Handling/Storage: Make sure all engineering systems (production, transportation) are of maximum explosion-proof design. Ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, producing, and sampling operations.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name: Xylene

DOT ID No. UN1307

DOT Label: Flammable Liquid

DOT Hazard Class: Flammable Liquid

IMO Label: Flammable Liquid

IMO Class: 3.2 or 3.3

References: 1, 2, 12, 73, 84-94, 100, 103.

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Prepared by PJ Igoe, BS

Industrial Hygiene Review: DJ Wilson, CIH

Medical Review: MJ Hardies, MD

APPENDIX D
INCIDENT REPORT FORM

**APPENDIX D
FORM HS-502
HAZARDOUS WASTE INCIDENT REPORT**

DATE **PROJECT/LOCATION** **BUSINESS UNIT**

**DESCRIPTION OF INCIDENT, INCLUDING INJURIES, PROPERTY DAMAGE
AND EMERGENCY ACTION TAKEN AND PERSONNEL INVOLVED (use
additional sheets if needed):**

WITNESSES OF INCIDENT:

POSSIBLE OR KNOWN CAUSES:

WHAT ACTIONS ARE NEEDED TO PREVENT A SIMILAR INCIDENT?

REPORTER

BUSINESS UNIT SAFETY OFFICER

PROJECT MANAGER

**CORPORATE HEALTH AND SAFETY
OFFICER**

APPENDIX E
HNU PHOTOIONIZATION DETECTOR

APPENDIX E

HNU PHOTOIONIZATION DETECTOR (MODEL PI 101)

The instrument is turned to the battery check position first. Assuming proper charge, the main control switch is set to the standby position using the zero knob. The instrument is then allowed to warm up for above five minutes in the standby mode. The calibration gas (usually isobutylene from the HNU factory) is attached. The proper range setting is selected (usually 0-200 ppm) and the calibration gas turned on.

The gas flows through a critical orifice which reduces its flow rate to the proper rate for calibration purposes. The normal factory calibration of this instrument is for benzene in air. Isobutylene is used for normal calibration because it is less toxic. The relative response of isobutylene as compared to benzene is about 70 percent with the 10.2 eV and 11.7 eV lamps (there is a slight difference between the relative response of the two different energy probes, but it is not considered significant for most field calibration purposes). Accordingly, a bottle of isobutylene calibration gas that contains 100 ppm isobutylene will read out as about 70 ppm on a factory calibrated instrument. A bottle of factory calibration gas will state the proper readout on the instrument "as benzene".

If the instrument does not calibrate exactly, the span pot knob is normally adjusted to bring the instrument into calibration. The normal "factory" settings are 9.8 for the 10.2 eV lamp and 5.90 for the 11.7 eV lamp. If the instrument cannot be brought into calibration by using the span pot, the lamp may need to be cleaned or other maintenance items performed so that the unit will calibrate accurately.

APPENDIX G

TRUST AGREEMENT

TRUST AGREEMENT

THIS AGREEMENT, entered into as of the ____ day of _____, 1995, by and between **CEDAR CHEMICAL CORPORATION**, a Delaware corporation (the "Grantor"), and **FIRST NATIONAL BANK**, Vicksburg, Mississippi (the "Trustee").

WHEREAS, pursuant to the provisions of Paragraphs V and VI of that certain Consent Decree entered in United States of America v. Cedar Chemical Corporation, Civil Action No. W92-0008(B), in the United States District Court for the Southern District of Mississippi (the "Consent Decree"), the Grantor is required to provide financial assurance for the closure of a container management area located on Grantor's Plant referred to in Exhibit A attached hereto in accordance with certain regulations of the Mississippi Department of Environmental Quality ("MSDEQ"), an agency of the State of Mississippi, and, in the event that said container management area cannot be "clean closed", to provide financial assurance for post-closure care of such area; and

WHEREAS, the Grantor has elected to establish a Trust to provide all or part of such financial assurance in accordance with regulations of the MSDEQ equivalent to 40 CFR §264.151 (a)(1), as required under the Consent Decree; and

WHEREAS, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the Trustee under this Agreement and the Trustee is willing to act as Trustee hereunder.

NOW, THEREFORE, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement:

(a) The term "Grantor" means the owner or operator who enters into this Agreement and any successors or assigns of the Grantor.

(b) The term "Trustee" means the Trustee who enters into this Agreement and any successor Trustee.

Section 2. Identification of Facilities and Cost Estimates. This agreement pertains to the facilities and closure cost estimates identified in attached Schedule A. In the event that this Trust shall also be intended to provide financial assurance for post-closure care of the said facilities, the Grantor will amend Schedule A by including a post-closure care cost estimate which shall be submitted to the Trustee along with additional

funds in such amount as shall provide assurance of such post-closure care, which amount the Grantor shall then add to the trust fund created hereby.

Section 3. Establishment of Fund. The Grantor and the Trustee hereby establish a trust fund (the "Fund") for the benefit of MSDEQ. The Grantor and the Trustee intend that no third party have access to the fund except as herein provided or as required hereafter pursuant to the Consent Decree. The Fund is established initially by the Grantor by the payment, in immediately available funds, of that sum specified in Schedule A attached hereto. Such property and any other property subsequently transferred to the Trustee is referred to as the Fund, together with all earnings and profits thereon, less any payments or distributions made by the Trustee pursuant to this Agreement. The fund shall be held by the Trustee, **IN TRUST**, as hereinafter provided. The Trustee shall not be responsible nor shall it undertake any responsibility for the amount of adequacy of, nor any duty to collect from the Grantor, any payments necessary to discharge any liabilities of the Grantor under the Consent Decree.

Section 4. Payment for Closure and Post-Closure Care. The Trustee shall make payments from the Fund as the Executive Director of MSDEQ shall direct, in writing, to provide for the payment of the costs of closure and, if applicable, of post-closure care of the facilities covered by this Agreement. The Trustee shall reimburse the Grantor or other persons as specified by the Executive Director of MSDEQ from the fund for closure and post-closure expenditures in such amounts as said Executive Director shall direct in writing. In addition, the Trustee shall refund to the Grantor such amounts as said Executive Director specifies in writing. Upon refund, such funds shall no longer constitute part of the Fund as defined herein.

Section 5. Payments Comprising the Fund. Payments made to the Trustee for the Fund shall consist of cash or securities acceptable to the Trustee.

Section 6. Trustee Management. The Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with general investment policies and guidelines which the Grantor may communicate in writing to the Trustee from time to time, subject, however, to the provisions of this section. In investing, reinvesting, exchanging, selling, and managing the Fund, the Trustee shall discharge its duties with

respect to the trust fund solely in the interest of the beneficiary and with the care, skill, prudence, and diligence under the circumstances then prevailing which persons of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims; except that:

(i) Securities or other obligations of the Grantor, or any other owner or operator of the facilities, or any of their affiliates as defined in the Investment Company Act of 1940, as amended 15 U.S.C. § 80a-s. (a), shall not be acquired or held, unless they are securities or other obligation of the Federal or State government;

(ii) The Trustee is authorized to invest the Fund in time or demand deposits of the Trustee, to the extent insured by an agency of the Federal or State government; and

(iii) The Trustee is authorized to hold cash awaiting investment or distribution uninvested for a reasonable time and without liability for the payment of interest thereon.

Section 7. Commingling and Investment. The trustee is expressly authorized in its discretion:

(a) To transfer from time to time any or all of the assets of the Fund to any common, commingled, or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions thereof, to be commingled with the assets of other trusts participating therein; and

(b) To purchase shares in any investment company registered under the Investment Company Act of 1940, 15 U.S.C. § 80 a-1 et seq., including one which may be created, managed, underwritten, or to which investment advice is rendered or the shares of which are sold by the Trustee. The Trustee may vote such shares in its discretion.

Section 8. Express Powers of Trustee. Without in any way limiting the powers and discretion conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered:

(a) To sell, exchange, convey, transfer, or otherwise dispose of any property held by it, by public or private sale. No person dealing with the Trustee shall be bound to see to the application of the purchase money or to inquire into the validity or expediency of any such sale or other disposition;

(b) To make, execute, acknowledge, and deliver any and all documents of transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted;

(c) To register any securities held in the fund in its own name or in the name of a nominee and to hold any security in bearer form or in book entry, or to combine certificates representing such securities with certificates of the same issue held by the Trustee in other fiduciary capacities, or to deposit or arrange for the deposit of such securities in a qualified central depository even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee of such depository with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the United States Government, or any agency or instrumentality thereof, with a Federal Reserve Bank, but the books and records of the Trustee shall at all times show that all such securities are part of the Fund;

(d) To deposit any cash in the fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the Federal or State government; and

(e) To compromise or otherwise adjust all claims in favor of or against the Fund.

Section 9. Taxes and Expenses. All taxes of any kind that may be assessed or levied against or in respect of the Fund that all brokerage commissions incurred by the Fund shall be paid from the Fund. All other expenses incurred by the Trustee in connection with the administration of this Trust, including fees for legal services rendered to the Trustee, the compensation of the Trustee to the extent not paid directly by the Grantor, and all other proper charges and disbursements of the Trustee shall be paid from the Fund.

Section 10. Annual Valuation. The Trustee shall annually, at least 30 days prior to the anniversary date of establishment of the Fund, furnish to the Grantor a statement confirming the value of the Trust. Any securities in the Fund shall be valued at market value as of no more than 60 days prior to the anniversary date of establishment of the fund. The failure of the Grantor to object in writing to the Trustee within 90 days after the statement has been furnished to the Grantor shall constitute a conclusively binding assent by the Grantor, barring the Grantor from asserting any claim or liability against the Trustee with respect to matters disclosed in the statement.

Section 11. Advise of Counsel. The Trustee may from time to time consult with counsel, who may be counsel to the Grantor, with respect to any question arising as

to the construction of this Agreement or any action to be taken hereunder. The Trustee shall be fully protected, to the extent permitted by law, in acting upon the advise of counsel.

Section 12. Trustee Compensation. The Trustee shall be entitled to reasonable compensation for its services as agreed upon in writing from time to time with the Grantor.

Section 13. Successor Trustee. The Trustee may resign or the Grantor may replace the Trustee, but such resignation or replacement shall not be effective until the Grantor has appointed a successor trustee and such successor accepts the appointment. The successor trustee shall have the same powers and duties as those conferred upon the Trustee hereunder. Upon the successor trustee's acceptance of the appointment, the Trustee shall assign, transfer, and pay over to the successor trustee the funds and properties then constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of successor trustee or for instructions. The successor trustee shall specify the date on which it assumes administration of the trust in a writing sent to the Grantor, the Executive Director of MSDEQ, and the present Trustee by certified mail 10 days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this Section shall be paid as provided in Section 9.

Section 14. Instructions to the Trustee. All orders, requests, and instructions by the Grantor to the Trustee shall be in writing, signed by Grantor's Secretary of Treasurer. The Trustee shall be fully protected in acting without inquiry in accordance with the Grantor's orders, requests, and instructions. All orders, requests, and instructions by the Executive Director of MSDEQ to the Trustee shall be in writing, signed by the said Executive Director or his designee, and the Trustee shall act and shall be fully protected in acting in accordance with such orders, requests, and instructions. The Trustee shall have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or MSDEQ hereunder has occurred. The Trustee shall have no duty to act in the absence of such orders, requests, and instructions from the Grantor and/or MSDEQ, except as provided herein.

Section 15. Notice of Nonpayment. If a payment for bodily injury or property damage is made under Section 4 of this trust, the Trustee shall notify the Grantor of such payment and the amount(s) thereof within five (5) working days. The Grantor shall, on

or before the anniversary date of the establishment of the Fund following such notice, either make payments to the Trustee in amounts sufficient to cause the trust to return to its value immediately prior to the payment of claims under Section 4, or shall provide written proof to the Trustee that other financial assurance for liability coverage has been obtained equalling the amount necessary to return the trust to its value prior to the payment of claims. If the Grantor does not either make payments to the Trustee or provide the Trustee with such proof, the Trustee shall within 10 working days after the anniversary date of the establishment of the Fund to provide a written notice of nonpayment to the Executive Director of MSDEQ.

Section 16. Amendment of Agreement. This Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee, and the Executive Director of MSDEQ.

Section 17. Irrevocability and Termination. Subject to the right of the parties to amend this Agreement as provided in Section 16, this Trust shall be irrevocable and shall continue until terminated at the written agreement of the Grantor, the Trustee, and the Executive Director of MSDEQ, if the Grantor ceases to exist. Upon termination of the Trust, all remaining trust property, less final trust administration expenses, shall be delivered to the Grantor.

The Executive Director of MSDEQ will agree to termination of the Trust when the owner or operator substitutes alternate financial assurance as specified in this section.

Section 18. Immunity and Indemnification. The Trustee shall not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this Trust, or in carrying out any directions by the Grantor or the Executive Director of MSDEQ issued in accordance with this Agreement. The Trustee shall be indemnified and saved harmless by the Grantor or from the Trust Fund, or both, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense in the event the Grantor fails to provide such defense.

Section 19. Choice of Law. This Agreement shall be administered, construed, and enforced according to the laws of the State of Mississippi.

Section 20. Interpretation. As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each section of this Agreement shall not affect the interpretation or the legal efficacy of this Agreement.

In Witness Whereof the parties have caused this Agreement to be executed by their respective officers duly authorized and their corporate seals to be hereunto affixed and attested as of the date first above written. The parties below certify that the wording of this Agreement is identical to the wording specified in 40 CFR 264.151 (m) as such regulations were constituted on the date first above written.

ATTEST:

CEDAR CHEMICAL CORPORATION

BY: _____

BY: _____

TITLE: _____

TITLE: _____

GRANTOR

[Seal]

ATTEST:

FIRST NATIONAL BANK,
Vicksburg, Mississippi

BY: _____

BY: _____

TITLE: _____

TITLE: _____

[Seal]

STATE OF TENNESSEE
COUNTY OF SHELBY

Before me, a Notary Public in and for said State and County, duly commissioned and qualified, personally appeared John C. Bumpers, with whom I am personally acquainted and who, upon oath, acknowledged himself to be the Senior Vice President/Finance and Administration of Cedar Chemical Corporation, and within named bargainor, a corporation, and that he, as such Senior Vice President/Finance and Administration, being authorized so to do, executed the foregoing instrument for the purposes herein contained by signing the name of the corporation by himself as such Vice President and Secretary.

WITNESS my hand and Notarial Seal at office this ____ day of _____, 1995.

NOTARY PUBLIC

My Commission Expires:

STATE OF MISSISSIPPI
COUNTY OF WARREN

Before me, a Notary Public in and for said State and County, duly commissioned and qualified, personally appeared _____, with whom I am personally acquainted and who, upon oath, acknowledged himself to be the _____, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing the name of the corporation by himself as such officer.

WITNESS my hand and Notarial Seal at office this ____ day of _____, 1995.

NOTARY PUBLIC

My Commission Expires:

EXHIBIT A

Facilities and Cost Estimates

Cedar Chemical Corporation
Vicksburg Chemical Company
Vicksburg Plant
Post Office Box 3
Vicksburg, Mississippi 39180

EPA ID# MSD 990714081

Closure (Container Storage Areas -
SWMU 1 and SWMU 17)

\$42,300